San Francisco Bay Region

The San Francisco Bay Region extends from Pescadero Creek in southern San Mateo County to the mouth of Tomales Bay in the north and inland to the confluence of the Sacramento and San Joaquin rivers near Collinsville. The total land area of the region is about 3 percent of the State's area. For much of the following discussion, the region is divided into the North Bay and South Bay planning subareas, which are divided by the bay waterways. (See Appendix C for maps of the planning subareas and land ownership in the region.)

The highest peaks of the Coast Range, which make up much of the eastern boundary, are over 3,000 feet above sea level. Other prominent geographic features include San Francisco, San Pablo, and Suisun bays, and the San Francisco and Marin peninsulas. The region also includes many small creeks which flow to the Pacific Ocean or into the bays.

The climate is generally cool and often foggy along the coast, with warmer Mediterranean-like weather in the inland valleys. The average high temperature is nearly 10 degrees higher inland than at San Francisco, resulting in higher outdoor water use in the inland areas. The gap in the hills at Carquinez Strait allows cool air to flow at times from the Pacific Ocean into the Sacramento Valley. Most of the interior North Bay and the northern parts of the South Bay also are influenced by this marine effect. The southern interior portions of the South Bay, by contrast, experience very little marine air movement. Average precipitation ranges from 14 inches at Livermore in the South Bay to almost 48 inches at Kentfield in Marin County in the North Bay.

Population

The region is highly urbanized and includes the San Francisco, Oakland, and San Jose metropolitan areas. There are large undeveloped areas in the western, northern, and southern parts of the region. In 1990, 18 percent of the State's total population lived in the region and almost 88 percent, or 4,800,000, of those residents lived in the South Bay. During the1980s, the region's population grew by approximately 695,000; the North Bay grew by about 20 percent and the South Bay grew by 14 percent.

In the North Bay PSA, the inland cities of Fairfield, Vallejo, Benicia, and Suisun City grew by 33, 36, 59, and 105 percent, respectively, from 1980 to 1990. These cities

Region Characteristics

Average Annual Precipitation: 31 inches

Average Annual Runoff: 1,245,500 af

Land Area: 4,400 square miles

Population: 5,484,000

alone accounted for an increase of almost 70,000 people during the decade. Over the same period, most of the cities in Marin County grew very slowly. San Rafael, the county's largest city, grew at a modest 8 percent, while Fairfax actually declined in population. Further north and east, Petaluma and Napa grew by 28 and 22 percent, respectively.

The most rapid growth in the South Bay PSA also took place in the eastern part of that area. A number of cities had growth rates greater than 40 percent during the 1980s, including Dublin, Martinez, Pittsburg, Pleasanton, and San Ramon. Hercules, in the northern part of the PSA, grew by 282 percent. Growth during the 1980s was numerically significant in the larger urban centers: Oakland (32,905), Fremont (41,394), San Francisco (44,985), and San Jose (152,702). Table SF-1 shows regional population projections.

Table SF-1. Population Projections
(thousands)

Planning Subarea	*1990*	*2000*	*2010*	*2020*
North Bay	680	817	889	941
South Bay	4,804	5,398	5,722	6,003
TOTAL	5,484	6,215	6,611	6,944

Land Use

Land use in the region is truly diverse. The San Francisco Bay Region is home to the world-famous Napa Valley and Sonoma County wine industry; international business and tourism in San Francisco; the technological development and production in the "Silicon Valley"; as well as urban, suburban, and rural living. Urban land accounts for 23 percent (655,600 acres) of the land area. Irrigated agricultural land in 1990 was 61,400 acres. Forecasted land use reflects an increase in urban areas to 870,900 acres, or 37 percent of the region's land area, by 2020. Point Reyes National Recreation Area, as well as other federal and State parks and reservoirs, make up a small portion of the total region.

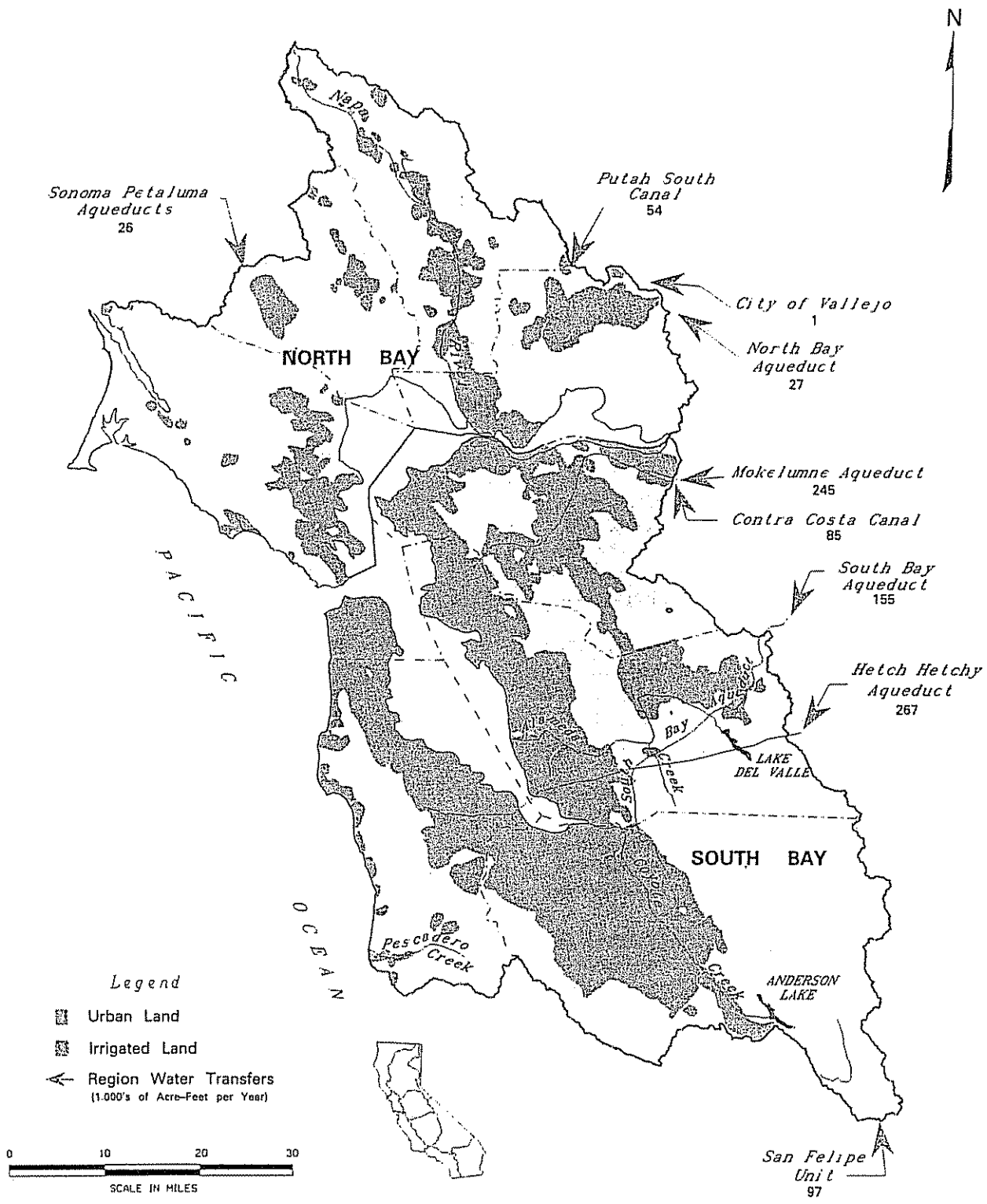
While a relatively large portion of the land area is urbanized, a wide variety of crops also are grown in the region. Agricultural land use is strongly influenced by the climatic and urban growth factors mentioned above. In almost every area of the region, urban development is encroaching on agricultural lands.

Within the North Bay, vineyards account for over three-fourths of the irrigated acres in Sonoma and Napa counties. There are 4,200 acres of pasture and about 3,900 acres of deciduous trees (primarily walnuts, prunes, and pears in Solano County) in the North Bay. The coastal area of the South Bay supports rangeland, flowers, and a number of high-value specialty vegetables, such as artichokes. Vegetables, flowers, vineyards, and many suburban ranchettes with irrigated pasture are found in the Santa Clara Valley. Alfalfa, truck crops, and wine grapes are grown in the Livermore Valley. Figure SF-1 shows land use, imports, and exports in the San Francisco Bay Region.

Water Supply

Water supply sources include local surface water, imported surface water (both locally developed and purchased from other local agencies), ground water, Central Valley Project water, other federal project water (Solano Project), State Water Project

Figure SF-1. San Francisco Bay Region
Land Use, Imports, and Exports



water, and a small amount of recycled waste water About 66 percent of the urban supplies are imported to the region Figure SF-2 shows the region s 1990 level sources of supply

Supply with Existing Facilities and Water Management Programs

Ground water is found in both the alluvial basins and upland hard rock areas. Well yields in the alluvial basins range from less than 100 to over 3,000 gallons per minute The yield from wells in the hard rock areas is generally much lower, but is usually sufficient for most domestic or livestock purposes Recharge to the alluvial basins occurs primarily from rainfall and seepage from adjacent streams However, a significant percentage, especially in the South Bay, is through artificial recharge facilities and incidental recharge from irrigation

For 1990, drought supplies (including dedicated natural flow) were 28 percent less than average. Supply reductions occurred in local surface and imported supplies. Ground water use increased primarily because users and suppliers often rely more heavily on storage in aquifers in dry years

The major reservoirs in the region are listed in Table SF-2. Table SF-3 shows water supplies with existing facilities and programs.

Table SF-2. Major Reservoirs

Reservoir Name	*River*	*Capacity (1,000 AF)*	*Owner*
Lake Hennessey	Conn Creek	31.0	City of Napa
Nicasio	Nicasio Creek	22.4	Marin MWD
Kent Lake	Lagunitas Creek	32.9	Marin MWD
Alpine	Lagunitas Creek	8.9	Marin MWD
Soulajule	Walker Creek	10.6	Marin MWD
San Pablo	San Pablo Creek	38.6	East Bay MUD
New Upper San Leandro	San Leandro Creek	41.4	East Bay MUD
Chabot	San Leandro Creek	10.4	East Bay MUD
Briones	Bear Creek	60.5	East Bay MUD
Del Valle	Arroyo del Valle	77.1	DWR
San Antonio Reservoir	San Antonio Creek	50.5	City of San Francisco
Coyote	Coyote Creek	22.9	Santa Clara Valley WD
Leroy Anderson	Coyote Creek	89.7	Santa Clara Valley WD
Lexington	Los Gatos Creek	19.8	Santa Clara Valley WD
Lake Elsman (Austrian)	Los Gatos Creek	6.2	San Jose Water Works
Calaveras	Calaveras Creek	96.9	City of San Francisco
San Andreas	San Andreas Creek	19.0	City of San Francisco
Crystal Springs	San Mateo Creek	58.4	City of San Francisco

North Bay. At the 1990 level, the average year local surface water supply for the North Bay is 226,000 af. This includes 150,000 af of local surface water used to meet Suisun Marsh wetlands requirements.

Marin Municipal Water District serves the most populated, southeastern portion of Marin County Local supply is obtained from its reservoirs in Marin County which can store about 79,600 af and supply up to 32,000 af annually, but have an estimated reliable supply of about 25,000 af per year.

North Marin Water District supplements its imported Sonoma County Water Agency supply with just over 1,000 af from Stafford Lake. The City of Napa uses local surface supply from Lake Hennessey and Lake Milliken, and St. Helena receives water from Bell Canyon Reservoir. The City of Vallejo gets water from Lake Curry in Napa County. Vineyards along the Napa River annually divert approximately 6,000 af from the river for irrigation and frost protection. Since no major local supply projects are anticipated, the local surface supplies are forecasted to remain constant through 2020.

Table SF-3. Water Supplies with Existing Facilities and Programs

(Decision 1485 Operating Criteria for Delta Supplies)

(thousands of acre-feet)

Supply	*1990*		*2000*		*2010*		*2020*	
	average	*drought*	*average*	*drought*	*average*	*drought*	*average*	*drought*
Surface								
Local	365	253	365	253	365	253	365	253
Local imports	539	503	563	514	587	514	591	514
Colorado River	0	0	0	0	0	0	0	0
CVP	180	160	213	183	228	183	232	183
Other federal	54	44	54	44	54	44	54	44
SWP[1]	182	124	213	126	208	121	208	122
Ground water[2]	100	139	126	174	160	174	165	174
Overdraft[3]	0	0	—	—	—	—	—	—
Reclaimed	36	36	36	36	36	36	36	36
Dedicated natural flow	4,615	3,085	4,615	3,085	4,615	3,085	4,615	3,085
TOTAL	6,071	4,344	6,185	4,415	6,253	4,410	6,266	4,411

(1) SWP supplies may be higher in any year to help recharge ground water basins for drought years.
(2) Average ground water use is prime supply of ground water basins and does not include use of ground water which is artificially recharged from surface sources into the ground water basins.
(3) The degree future shortages are met by increased overdraft is unknown. Since overdraft is not sustainable, it is not included as a future supply.

Imports by Local Agencies. In the North Bay, water is imported from the Russian and Eel rivers (North Coast Region) by Sonoma County Water Agency and from the Delta by the City of Vallejo through the SWP. Sonoma County Water Agency delivers water from the Russian River Project (which includes Lake Mendocino and Lake Sonoma, and the Potter Valley Project) to eight principal contractors, including four in the San Francisco Bay Region (Petaluma, Sonoma, Valley of the Moon, and North Marin water districts).

Marin Municipal Water District currently supplements its local supply with 4,300 af from Sonoma County Water Agency, according to their "Off-peak Water Agreement." MMWD recently negotiated a new agreement with SCWA for an additional 10,000 af "as available." MMWD is now seeking to make these contracts as reliable as possible by working with SCWA, expanding its own conveyance facilities, and supporting SCWA in its SWRCB water rights permit application.

Ground water. The North Bay 1990 level average supply of ground water is about 24,000 af. The increase in ground water supply during drought years reflects a greater dependence on ground water during periods of surface water deficiencies. Future ground water supply is projected to remain fairly constant.

The larger alluvial basins in the North Bay PSA include Suisun-Fairfield Valley, Napa Valley-Sonoma Valley, Petaluma Valley, and Novato Valley. Ground water levels indicate the basins are probably not in overdraft. Estimated ground water storage in the basins is 1,700,000 af. Salt water intrusion has been a problem in the bayside portions of the Sonoma and Napa valleys, but this has been substantially mitigated by using imported surface water instead of ground water. The ground water quality in the North Bay is generally good. Some isolated areas experience elevated levels of dissolved solids, iron, boron, hardness, and chloride. High levels of nitrates occur in the Napa and Petaluma valleys as a result of past agricultural practices.

Other Federal Projects. Solano County Water Agency contracts for water from Lake Berryessa via the Solano Project and delivers it to farmers and cities within the county. The project was built by the U.S. Bureau of Reclamation and began operation in 1959. The project has an annual dependable supply of 201,000 af but can deliver as much as 212,000 af. The majority of the Solano Project entitlement water goes to agricultural users in the Sacramento River Region. The 1990 level average project supply for the North Bay is 54,000 af. The drought year supply shows a 15-percent deficiency, which was imposed by the USBR in 1991. Solano County Water Agency supplies are projected to increase only slightly through 2020.

State Water Project. The SWP delivers water through the North Bay Aqueduct to the Solano County Water Agency and Napa County Flood Control and Water Conservation District. The Aqueduct extends over 27 miles from Barker Slough to the Napa Turnout Reservoir in southern Napa County. Maximum SWP entitlements are for 67,000 af annually. The Aqueduct also conveys water for the City of Vallejo, which purchased capacity in the NBA.

Water Recycling. About 800 af of recycled water is used in Marin, Napa, and southern Sonoma counties, primarily for landscape irrigation. In Solano County, over 2,000 af of water is recycled by the Fairfield-Suisun Sewer District for agricultural irrigation, mostly on turf farms. The total 1990 average and drought year recycled water supply in the North Bay is 3,000 af.

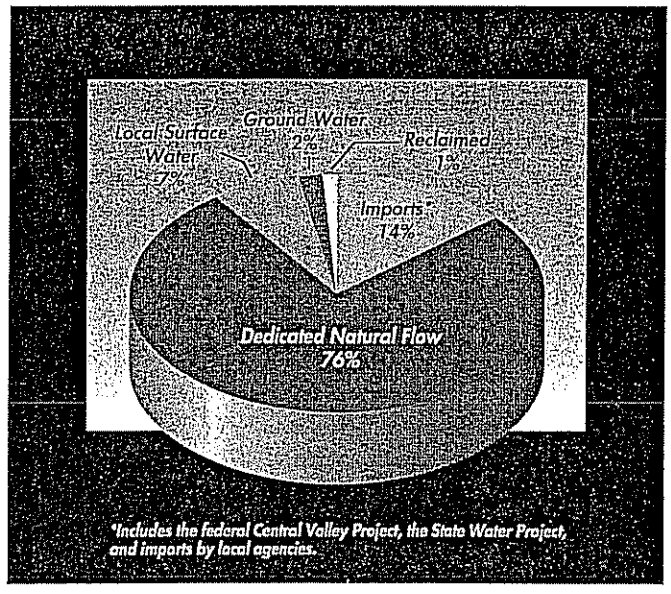


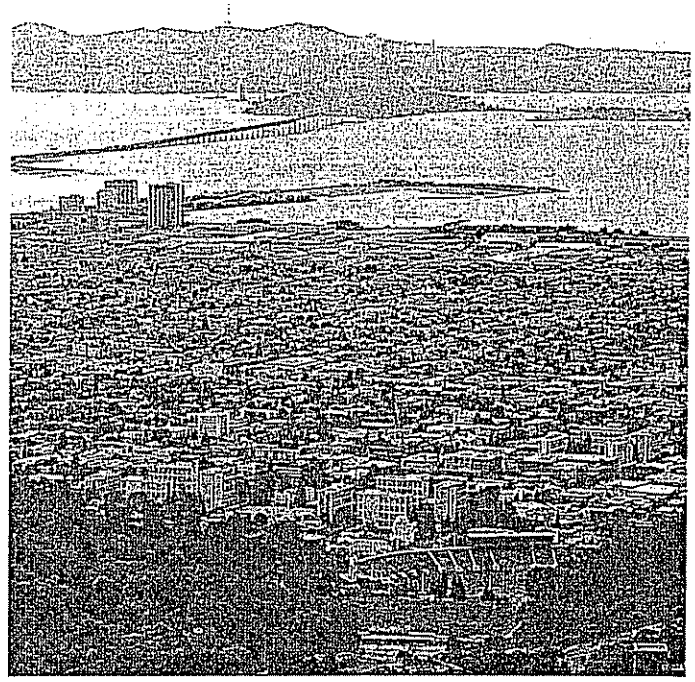
Figure SF-2. San Francisco Bay Region Water Supply Sources (1990 Level Average Conditions)

South Bay. The 1990 average local surface supply for the South Bay is 139,000 af. The drought year shortage is significantly affected by a 67-percent reduction in local surface supplies. Future supplies from existing facilities should remain relatively constant through 2020.

Imports by Local Agencies. San Francisco Water District imports Tuolumne River water via the 150-mile-long Hetch Hetchy System. In addition to supplying water to the City and County of San Francisco, SFWD sells water wholesale to 30 water districts, cities, and local agencies in Alameda, Santa

Clara, and San Mateo counties SFWD now has three pipelines capable of delivering 336,000 af annually to the Bay Area

EBMUD imports water from the Mokelumne River through its aqueducts and delivers water to much of Alameda and Contra Costa counties The district supplies water to approximately 1,200,000 people in 20 cities and 15 unincorporated communities EBMUD has water rights and facilities to divert up to 364,000 af annually from the Mokelumne River, depending on streamflow and water use by other water rights holders



The San Francisco Bay Region relies on imported water for most of its urban and agricultural supplies Increases in population will require water supply planners to face the challenges of meeting increased demand with limited supply.

Ground water. The major ground water basins of the South Bay PSA include Santa Clara Valley. Livermore Valley, and the Pittsburg Plain. The total ground water storage in the South Bay basins is estimated to be 6,500,000 af.

Artificial recharge programs are in place in several South Bay localities Alameda County Flood Control & Water Conservation District, Zone 7, uses several abandoned gravel pits to recharge ground water in the Livermore Valley Alameda County Water District uses a series of artificial barriers and abandoned gravel pits to slow runoff and increase percolation in and along Alameda Creek

Santa Clara Valley Water District has supplemented the ground water basin yield by developing an extensive recharge program. SCVWD augments the natural recharge by artificial recharge in percolation ponds and streambeds of major creeks in the Santa Clara Valley subbasins. Ground water users pay for ground water replenishment through a ground water charge based on measured ground water use. SCVWD manages an extensive conjunctive use program and during water supply shortages provides a financial incentive to influence water retailers to choose between ground water and treated surface water

These programs have resulted in a general rise to near-historic highs in ground water levels in many of the basins Recharge and surface water substitution in the Pittsburg Plain were successful in restoring ground water basins which were overdrafted in the past These efforts mitigated or eliminated low ground water level problems, such as salt water intrusion in the Pittsburg Plain Land subsidence in northern Santa Clara Valley has also been controlled Alameda County Water District has begun an Aquifer Reclamation Program to mitigate salt water intrusion into its ground water basin near San Francisco Bay The program includes pumping and disposing of saline water using a series of wells and creating a salinity intrusion barrier using 4-5 wells in the upper aquifer The district anticipates that the basin's annual

perennial yield will be increased 3,500 af at the completion of the Aquifer Reclamation Program.

Ground water quality is still a problem to various degrees in many South Bay locations. The Livermore Valley has elevated levels of dissolved solids, chloride, boron, and hardness. The highly urbanized areas of the Santa Clara Valley have experienced ground water pollution over large areas from organic solvents used in electronics manufacturing. However, SCVWD has an extensive ground water protection program to administer ground water cleanup operations and to prevent degradation of the ground water basin through well sealing and ground water quality monitoring.

Central Valley Project. CVP water is delivered through the Contra Costa Canal to Contra Costa Water District and through the San Felipe Project to SCVWD. CCWD delivers water throughout eastern Contra Costa County, including a portion of the district in the San Joaquin River Region. CVP water was first delivered by CCWD in 1940. The current contract with USBR is for a supply of 195,000 af per year. The district also has a right to divert almost 27,000 af from Mallard Slough on Suisun Bay. Most of CCWD's demands are met through direct diversions from the Delta through the Contra Costa Canal. CCWD has very little regulatory or emergency water supply storage to replace Delta supplies when water quality is poor. As a result, CCWD service area voters authorized funding for Los Vaqueros Reservoir in 1988. The proposed reservoir will improve supply reliability and water quality by allowing the district to pump and store water from the Delta during high flows.

SCVWD's maximum entitlement from the CVP's San Felipe Division, which became operational in 1987, is 152,500 af. Average 1990 deliveries to the region are about 93,200 af. By 1989, much sooner than anticipated, the district was requesting, but did not receive, its full entitlement to reduce impacts of the 1987-92 drought. Normally, about one-half of the CVP water is used for recharge; the rest is used as direct supply.

State Water Project. The South Bay Aqueduct conveys SWP water to SCVWD, ACFC&WCD Zone 7, and ACWD. The aqueduct is over 42 miles long beginning at SWP's South Bay pumping plant on Bethany Reservoir and ending at the Santa Clara Terminal Facilities. SWP water is used in South Bay PSA for municipal and industrial supply, agricultural deliveries, and ground water recharge.

Water Recycling. There are several water recycling projects in the South Bay PSA which provide 33,000 af to various uses such as environmental, industrial, landscape, and construction.

Supplies with Additional Facilities and Water Management Programs

With increasing populations and the resulting increased water demand, Bay Area water agencies are looking at a number of options to increase supplies as well as ensure the reliability of their existing water sources. Future water management options are presented in two levels to better reflect the status of investigations required to implement them.

- Level I options are those programs that have undergone extensive investigation and environmental analyses and are judged to have a high likelihood of being implemented by 2020.
- Level II options are those programs that could fill the remaining gap between water supply and demand. These options require more investigation and alternative analyses.

Supplies in the North Bay are adequate during average years to meet the water demand through 2020. For drought years, shortages range from 36,000 af in 1990 to 67,000 af in 2020 with existing facilities. With additional facilities, drought year shortages are reduced to about 33,000 af in 2020. Some areas that may have difficulty meeting water demand include MMWD, the Solano Project service area, and SWP contractor service areas. MMWD has the ability to use unused conveyance space in Sonoma County Water Agency and NMWD aqueducts, thus improving the water district's water supply reliability through water transfer. In November 1992, district voters approved funding for a program which includes building new facilities to eliminate or at least lessen the district's reliance on surplus capacity in NMWD and SCWA aqueducts.

With existing facilities, the South Bay's shortages would be about 30,000 af in 2020 during average years. During drought years, with existing facilities, shortages will increase from 272,000 af in 1990 to 417,000 af in 2020. With additional facilities, the South Bay will be able to meet average year demands to 2020 and drought year supply shortages would be reduced to about 228,000 af. Each of the six major water agencies in the South Bay is served by at least one of the import water systems connected to the Delta. These connections allow the transfer of water from agencies upstream of the Delta. Table SF-4 shows regional water supplies with additional (Level I) water management programs.

Table SF-4. Water Supplies with Level I Water Management Programs

(Decision 1485 Operating Criteria for Delta Supplies)

(thousands of acre-feet)

Supply	*1990*		*2000*		*2010*		*2020*	
	average	*drought*	*average*	*drought*	*average*	*drought*	*average*	*drought*
Surface								
Local	365	253	365	253	365	253	365	253
Local imports	539	503	563	557	587	557	591	557
Colorado River	0	0	0	0	0	0	0	0
CVP	180	160	213	183	228	183	232	183
Other federal	54	44	54	44	54	44	54	44
SWP[1]	182	124	220	130	212	200	216	201
Ground water[2]	100	139	87	194	87	194	110	198
Overdraft[3]	0	0	—	—	—	—	—	—
Reclaimed	36	36	74	74	111	111	119	119
Dedicated natural flow	4,615	3,085	4,609	3,079	4,609	3,079	4,609	3,079
TOTAL	6,071	4,344	6,185	4,514	6,253	4,621	6,296	4,634

(1) SWP supplies may be higher in any year to help recharge ground water basins for drought years.
(2) Average ground water use is prime supply of ground water basins and does not include use of ground water which is artificially recharged from surface sources into the ground water basins.
(3) The degree future shortages are met by increased overdraft is unknown. Since overdraft is not sustainable, it is not included as a future supply.

Water Supply Reliability and Drought Management Strategies. The San Francisco Bay Region weathered both the 1976-77 and 1987-92 droughts with moderate but only temporary impacts. These experiences verify that the region's flexibility to move water efficiently is a valuable asset in drought years. Three major factors contribute to this flexibility and the region's successful drought strategies: (1) effective water conservation and rationing programs, (2) available interconnections

between water providers, and (3) diversity of water sources. While the region's dependency on somewhat less reliable imported supplies is substantial in drought years, water sources are geographically diverse and emergency supplies and water transfers can help alleviate drought impacts. The following paragraphs describe some recent drought management actions taken in the region.

During the 1976-77 drought, MMWD received supplemental water through an elaborate sequence of interconnections. The transfer involved delivery of SWP water made available by agencies in Southern California, which took more water from the Colorado River. Water was conveyed through the South Bay Aqueduct and then by exchange and interconnected through the water systems of the SFWD, City of Hayward, and EBMUD, to a temporary pipeline across the Richmond-San Rafael Bridge. During the 1987–92 drought, MMWD customers achieved a 39-percent reduction in water use during the voluntary reduction period targeted at 25 percent.

Another example of drought-induced interconnections occurred during the recent drought when SFWD requested DWR to install the San Antonio turnout from the SWP South Bay Aqueduct that had also been used in the 1976-77 drought.

EBMUD has facilities to transfer water to both CCWD and the City of Hayward, while SFWD is able to transfer water to SCVWD. All of the major agencies of the South Bay have access to facilities capable of transferring water from other agencies upstream of the Delta. These transfers can be brought in through the Contra Costa Canal (CVP), the South Bay Aqueduct (SWP), or the San Felipe Project (CVP). During the recent drought, EBMUD adopted both voluntary and mandatory water use reduction programs of up to 25 percent.

SCVWD received 32 percent of its maximum CVP supply in 1991, which included 10,000 af of hardship supply. In addition, it received 30 percent of its SWP supply. As a result of these deficient supplies, the district elected to purchase 14,000 af of water from Placer County Water Agency, 26,000 af of water from Yuba County, and 20,000 af from the 1991 State Drought Water Bank. In addition to supplementing its supplies, the district instituted conservation programs designed to save 25 percent of 1987 water use.

Locally imported supplies by SFWD and EBMUD also suffered deficiencies during the recent drought. The Hetch Hetchy deficiency was reduced from an initial 45 to 25 percent for 1991. Customers were required to reduce indoor use by 10 percent and outdoor use by 60 percent. The deficiency reduction was made possible by purchases of 50,000 af from the 1991 State Drought Water Bank and 20,000 af from PCWA.

ACWD and ACFC&WCD, Zone 7 were both subject to 80-percent deficiencies in their 1991 SWP supplies. ACWD received 14,800 af from the 1991 State Drought Water Bank and an increase in its share of Lake Del Valle supplies. These supplemental supplies allowed the district to scale back its rationing plan to 25 percent reductions. ACFC&WCD, Zone 7 was able to make up for SWP deficiencies by increased ground water pumping. ACFC&WCD, Zone 7 also acquired a small supplemental supply from the 1991 State Drought Water Bank and instituted a conservation education program with a 25-percent reduction goal.

Future Water Management Options. Since 1975 MMWD has had one of the least reliable supplies in the Bay Area. The district had to rely on supplemental imported supply from Sonoma County Water Agency and a very responsive reduction effort by customers to ensure adequate supplies throughout the 1987–92 drought.

Assuming "base case" growth to 2025 and no supplemental supplies, the district had estimated a 40-percent deficiency once every 10 years MMWD's new contract with SCWA will decrease that deficiency to approximately 10 percent.

MMWD currently has no participation rights in SCWA facilities and uses excess capacity in SCWA's and NMWD's systems to convey Russian River water to Novato and into the MMWD system. MMWD developed and voters approved an Integrated Water Resources Management Program, which includes conservation, recycled water, and facilities expansion to accommodate the increased imported supply from the Russian River The program is intended to provide sufficient supply to the district through 2025 and allows for manageable deficiencies in dry years, which will minimize costs and environmental impacts.

Other suppliers in the area are much less vulnerable. Solano County Water Agency's principal contractors, for example, have very reliable supplies. Using historic hydrology and 2010 demands, Solano County Water Agency forecasts no supply deficiencies for the system.

EBMUD's supply is vulnerable in at least three ways: (1) drought, (2) decreasing availability of supplies due to increased use by senior water rights holders and an increasing emphasis on environmental needs, and (3) the integrity of its delivery system, especially the security of the aqueducts from earthquakes or floods as they cross the Delta. EBMUD has recently completed work on an Updated Water Supply Management Program that includes a number of improvements to its water supply system. A detailed discussion of this program is in Volume I, Chapter 11 A main element of EBMUD's program is the conjunctive use of ground water. In average and wet years, available water would be stored in ground water aquifers in the lower Mokelumne River basin and withdrawn in dry years. This program will yield 43,000 af in drought years. EBMUD's Board of Directors has also directed the district's staff to continue working with San Joaquin County water interests regarding development of a joint conjunctive use project, with the option of using the district's contract with USBR for 150,000 af per year of American River water.

Local imported supply would increase by 43,000 af in the future for drought years, reflecting EBMUD's conjunctive use alternative. American River water is potentially available from a previously unused CVP contract for 150,000 af that was originally to be delivered through Folsom South Canal to the Mokelumne Aqueducts. The district is still considering building its own extension of the Folsom South Canal so water could be delivered to its aqueducts.

As described previously, CCWD is pursuing the development of Los Vaqueros Reservoir near Byron to secure additional reliability and better quality for its water supplies. In addition, water recycling projects are becoming a cost-effective method of meeting increased demand in the San Francisco Bay Region By 2020, the region could have an additional supply of about 83,000 af of recycled water to help meet its demands.

Water Use

Water use in the region has undergone dramatic changes over the last 40 years. A 1949 land use survey recorded 163,000 acres of irrigated agriculture in the region; the 1990 level land use analysis showed 61,400 acres, a 62-percent reduction. The 1990 level agricultural net water demand was 88,000 af. Urban water demand was 1,186,000 af; and environmental water use was about 4,775,000 af. Almost all environmental water use in the region is associated with the Suisun Marsh demands and required Delta outflow. Total water use is forecasted to increase from approximately 6,071,000 af in 1990 to 6,296,000 af in 2020, primarily due to population increases. Figure SF-3 shows the distribution of 1990 level net water demands for the San Francisco Bay Region.

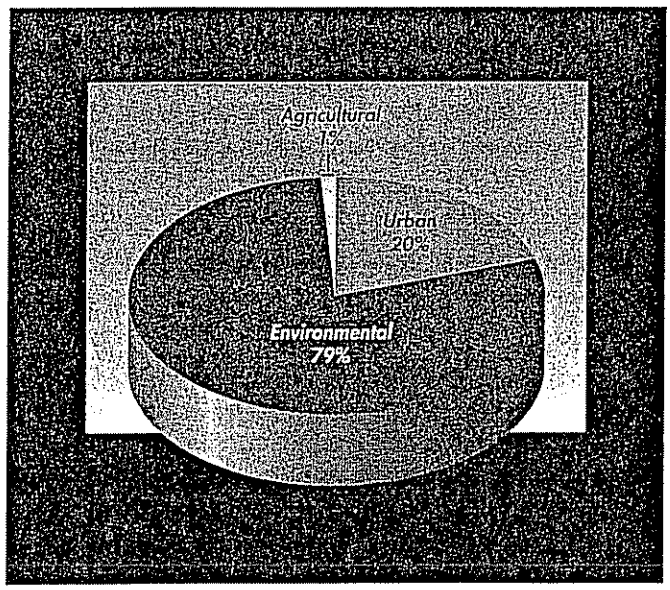


Figure SF-3. San Francisco Bay Region Net Water Demand (1990 Level Average Conditions)

Urban Water Use

Urban water demand is computed using population and per capita water use. Census data and State Department of Finance projections were used to tabulate the region's population. Per capita use in the region varies significantly, depending on factors such as climate, income, population density, residential yard size, and volume of commercial and industrial use. Generally, per capita use showed an upward trend after the 1976-77 drought to pre-drought levels. Recently, per capita use values have dropped again, although not to the levels of the previous drought. This most recent drop is due to conservation efforts during the 1987-92 drought. After a return to near-normal use, per capita use is forecasted to continue to drop slowly over the next three decades due to implementation of Best Management Practices (Volume I, Chapter 6).

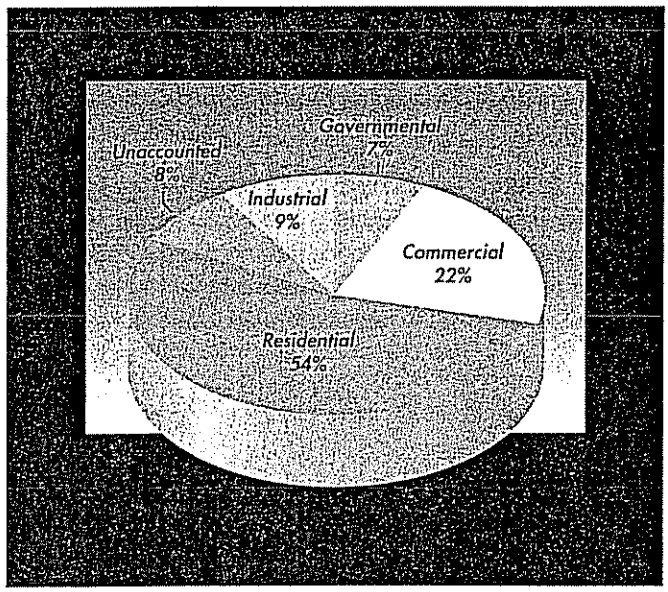


Figure SF-4. San Francisco Bay Region Urban Applied Water Use by Sector (1990 Level Average Conditions)

The cooler coastal portions of the region have the lowest per capita water use. The low per capita use values of approximately 100 gpcd in San Mateo County and 139 gpcd in San Francisco are generally related to a cooler climate, small yards, and higher population densities than in inland areas. Bayside communities in Marin and Sonoma counties use approximately 170 gpcd.

Santa Clara County's per capita use averages approximately 200 gpcd. The warmer and drier climate results in increased outdoor use. Residential areas reflect a range of uses, from high-density multi-unit dwellings to some areas of very low density suburban homes. The county also has a mix of water-using industries, such as food processing and computer and electronics manufacturing, which tend to raise per capita use.

The highest per capita use in the South Bay is in Contra Costa County, where use averages 230 gpcd because many residential areas consist of large estate-size lots which have high landscape water requirements; there also is considerable industrial water use concentrated along the Bay. The average daily per capita use for the region was 193 gallons in 1990. Figure SF-4 shows applied 1990 level urban water use by sector.

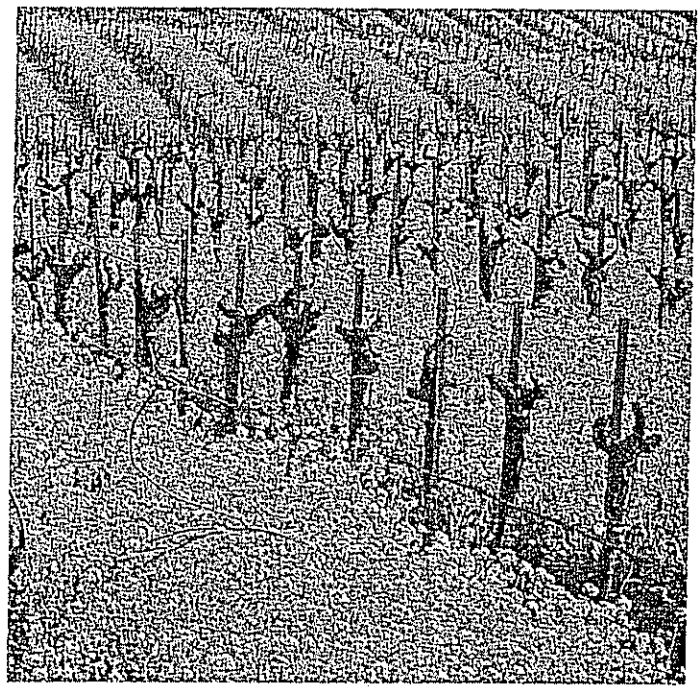
Urban water demands are displayed in Table SF-5. With a 27-percent increase in population anticipated by 2020, urban water demand is forecasted to increase roughly 19 percent after accounting for increases in household population density and savings from implementing water conservation measures such as urban Best Management Practices. The overall regional per capita use should decrease by about 6 percent by 2020.

Table SF-5. Urban Water Demand
(thousands of acre-feet)

Planning Subarea	*1990*		*2000*		*2010*		*2020*	
	average	*drought*	*average*	*drought*	*average*	*drought*	*average*	*drought*
North Bay								
Applied water demand	153	167	176	193	190	218	198	228
Net water demand	153	167	176	193	190	218	198	228
Depletion	135	148	156	171	168	194	176	203
South Bay								
Applied water demand	1,033	1,120	1,122	1,197	1,175	1,268	1,208	1,302
Net water demand	1,033	1,120	1,122	1,197	1,175	1,268	1,208	1,302
Depletion	944	1,027	1,029	1,100	1,079	1,168	1,111	1,200
TOTAL								
Applied water demand	1,186	1,287	1,298	1,390	1,365	1,486	1,406	1,530
Net water demand	1,186	1,287	1,298	1,390	1,365	1,486	1,406	1,530
Depletion	1,079	1,175	1,185	1,271	1,247	1,362	1,287	1,403

Agricultural Water Use

Figure SF-5 shows the irrigated acreage, ETAW, and applied water for major crops grown in the region. The following sections discuss agricultural water use in the North and South Bay areas.



Vineyard acreage is increasing in the Napa Valley. Most water for irrigation comes from ground water or diversions from the Napa River. Drip irrigation is one of many efficient practices that agricultural users are instituting in the area.

North Bay. Agricultural water use in the North Bay is influenced by the climate of the area. The cool air entering San Pablo Bay from the west is a factor in determining crop viability and irrigation practices. There is very little agriculture remaining in Marin County, currently about 700 irrigated acres. Sonoma and Napa counties, on the other hand, have actually increased agricultural acreage, due to an increase in vineyards and adoption of drip irrigation on lands too steep for furrow or sprinkler irrigation practices. Most of these agricultural lands are served by ground water or direct diversions from the Napa River and other local streams. Forecasts are that vineyard acreage will continue to increase, while other crop acreages, with the exception of pasture (forecasted to decrease 20 percent), are expected to remain about the same.

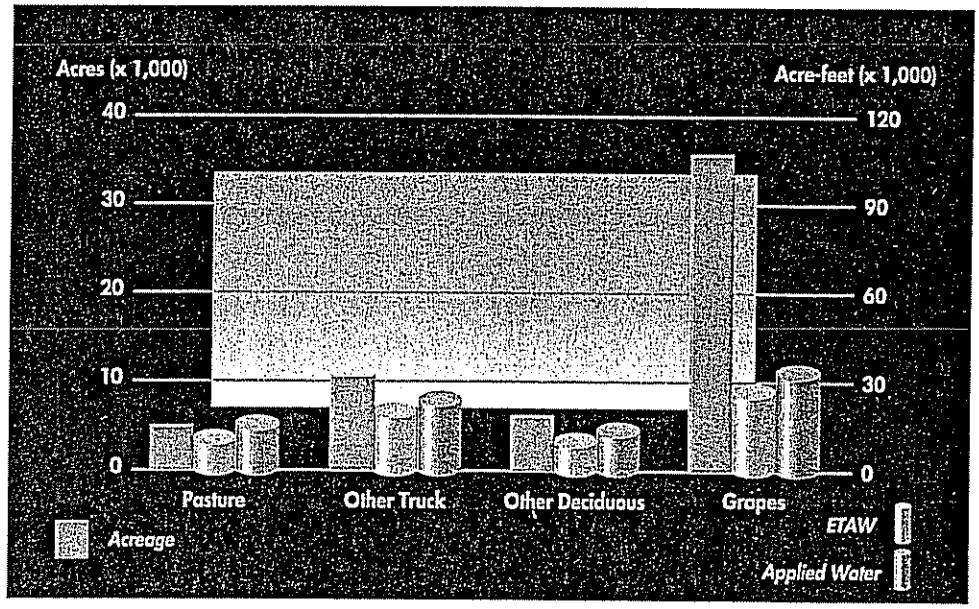


Figure SF-5. 1990 San Francisco Bay Region Acreage, ETAW, and Applied Water for Major Crops

South Bay. The climate of the South Bay is warmer as you move inland from the coast. The area produces many high-value crops including artichokes, brussels sprouts, and cut flowers The Santa Clara Valley was historically one of the garden spots for California agriculture. Urbanization over the last 40 years has reduced irrigated agricultural acreage from over 100,000 acres to less than 17,000 in 1990. Most of the remaining lands in production are along the Highway 101 corridor, north of Morgan Hill Crops grown are primarily high-value truck, fruit, and nut crops. Also, one- to five-acre suburban ranchettes, with sprinkler-irrigated pasture for horses, are now found on formerly nonirrigated range land and compete for limited ground water supplies

Table SF-6. Irrigated Crop Acreage
(thousands of acres)

Planning Subarea	*1990*	*2000*	*2010*	*2020*
North Bay	44	48	48	48
South Bay	17	16	16	16
TOTAL	61	64	64	64

The Livermore Valley is partially separated from interior Bay climate patterns by the Diablo Range. The valley is significantly warmer, reflected in higher outdoor water use. There are approximately 2,500 acres of irrigated agriculture, primarily vineyards, grain, and truck crops

Table SF-6 shows the irrigated agricultural land use by PSA and for the region, for 1990 through 2020. Table SF-7 shows 1990 evapotranspiration of applied water by crop. Table SF-8 summarizes the 1990 and forecasted agricultural water demand in the region

Table SF-7. 1990 Evapotranspiration of Applied Water by Crop

Irrigated Crop	*Total Acres (1,000)*	*Total ETAW (1,000 AF)*
Grain	2	1
Corn	1	1
Other field	1	1
Pasture	5	11
Other truck	10	19
Other deciduous	6	10
Vineyard	36	27
TOTAL	61	70

Table SF-8. Agricultural Water Demand
(thousands of acre-feet)

Planning Subarea	1990		2000		2010		2020	
	average	drought	average	drought	average	drought	average	drought
North Bay								
Applied water demand	57	65	59	65	59	66	59	66
Net water demand	53	61	55	61	55	62	55	62
Depletion	48	55	50	55	50	56	50	56
South Bay								
Applied water demand	35	38	35	39	35	38	35	37
Net water demand	35	38	35	39	35	38	35	37
Depletion	32	34	32	35	32	34	32	33
TOTAL								
Applied water demand	92	103	94	104	94	104	94	103
Net water demand	88	99	90	100	90	100	90	99
Depletion	80	89	82	90	82	90	82	89

Environmental Water Use

The Suisun Marsh and Hayward Marsh are the only identified managed wetlands in the San Francisco Bay Region requiring water supplies. The Suisun Marsh consists of approximately 55,000 acres of managed wetlands. The State owns about 10,000 acres while about 44,000 acres are under private ownership and managed as duck clubs. The estimated water demand of the marsh is about 150,000 af per year. The additional instream demands for the Suisun Marsh are about 15,000 af in an average year and 145,000 af during drought years and is included in environmental instream water needs (Table SF-10). Additional Suisun Marsh instream demands are based on an estimated supplemental flow required over the eight-month period when Suisun Marsh Salinity Gates are operational to meet SWRCB D-1485 standards downstream of the gates in the Delta. The Hayward Marsh is a part of the Hayward Shoreline Marsh Expansion Project. The project represents an effort by several local agencies working together to create the largest wetlands restoration project on the west coast. The 1,800-acre site is managed by the East Bay Regional Park District. As part of the project, 10,000 af of recycled water from the Union Sanitary District is blended with the Bay's brackish water and applied to the 145-acre marsh, restoring habitat for fish, waterfowl, and the endangered salt marsh harvest mouse. Table SF-9 shows wetlands water needs.

Table SF-9. Wetland Water Needs
(thousands of acre-feet)

Wetland	1990		2000		2010		2020	
	average	drought	average	drought	average	drought	average	drought
Suisun Marsh								
Applied water demand	150	150	150	150	150	150	150	150
Net water demand	150	150	150	150	150	150	150	150
Depletion	150	150	150	150	150	150	150	150
Hayward Marsh								
Applied water demand	10	10	10	10	10	10	10	10
Net water demand	10	10	10	10	10	10	10	10
Depletion	10	10	10	10	10	10	10	10
TOTAL								
Applied water demand	160	160	160	160	160	160	160	160
Net water demand	160	160	160	160	160	160	160	160
Depletion	160	160	160	160	160	160	160	160

The largest environmental water use in the region is for Delta outflow to meet SWRCB D-1485 salinity requirements, which requires about 4,600,000 and 2,940,000 af for average and drought years, respectively. Other instream flows for small streams throughout the region were not included in the water use tables. Environmental instream water needs are shown in Table SF-10 and includes Suisun Marsh instream needs. Recent and future actions to protect aquatic species in the Delta will increase environmental water needs for this region. Volume I, Chapter 8 presents a broad discussion of water needs for the Bay-Delta.

Table SF-10. Environmental Instream Water Needs
(thousands of acre-feet)

Stream	1990		2000		2010		2020	
	average	drought	average	drought	average	drought	average	drought
Bay-Delta								
Applied water demand	4,615	3,085	4,615	3,085	4,615	3,085	4,615	3,085
Net water demand	4,615	3,085	4,615	3,085	4,615	3,085	4,615	3,085
Depletion	4,615	3,085	4,615	3,085	4,615	3,085	4,615	3,085
TOTAL								
Applied water demand	4,615	3,085	4,615	3,085	4,615	3,085	4,615	3,085
Net water demand	4,615	3,085	4,615	3,085	4,615	3,085	4,615	3,085
Depletion	4,615	3,085	4,615	3,085	4,615	3,085	4,615	3,085

Other Water Use

Other water demand includes water losses by major conveyance facilities in the region, water needs of recreational facilities, and water demand of power plants and other energy production. Figure SF-6 shows water recreation areas in the San Francisco Bay Area. Table SF-11 shows the total water demand for 1990 and forecasts to 2020 for the San Francisco Bay Region.

Table SF-11. Total Water Demands
(thousands of acre-feet)

Category of Use	*1990*		*2000*		*2010*		*2020*	
	average	*drought*	*average*	*drought*	*average*	*drought*	*average*	*drought*
Urban								
Applied water demand	1,186	1,287	1,298	1,390	1,365	1,486	1,406	1,530
Net water demand	1,186	1,287	1,298	1,390	1,365	1,486	1,406	1,530
Depletion	1,079	1,175	1,185	1,271	1,247	1,362	1,287	1,403
Agricultural								
Applied water demand	92	103	94	104	94	104	94	103
Net water demand	88	99	90	100	90	100	90	99
Depletion	80	89	82	90	82	90	82	89
Environmental								
Applied water demand	4,775	3,245	4,775	3,245	4,775	3,245	4,775	3,245
Net water demand	4,775	3,245	4,775	3,245	4,775	3,245	4,775	3,245
Depletion	4,775	3,245	4,775	3,245	4,775	3,245	4,775	3,245
Other[1]								
Applied water demand	4	4	4	4	4	4	4	4
Net water demand	22	21	22	21	23	21	25	21
Depletion	22	21	22	21	23	21	25	21
TOTAL								
Applied water demand	6,057	4,639	6,171	4,743	6,238	4,839	6,279	4,882
Net water demand	6,071	4,652	6,185	4,756	6,253	4,852	6,296	4,895
Depletion	5,956	4,530	6,064	4,627	6,127	4,718	6,169	4,758

(1) Includes major conveyance facility losses, recreation uses, and energy production.

Issues Affecting Local Water Resource Management

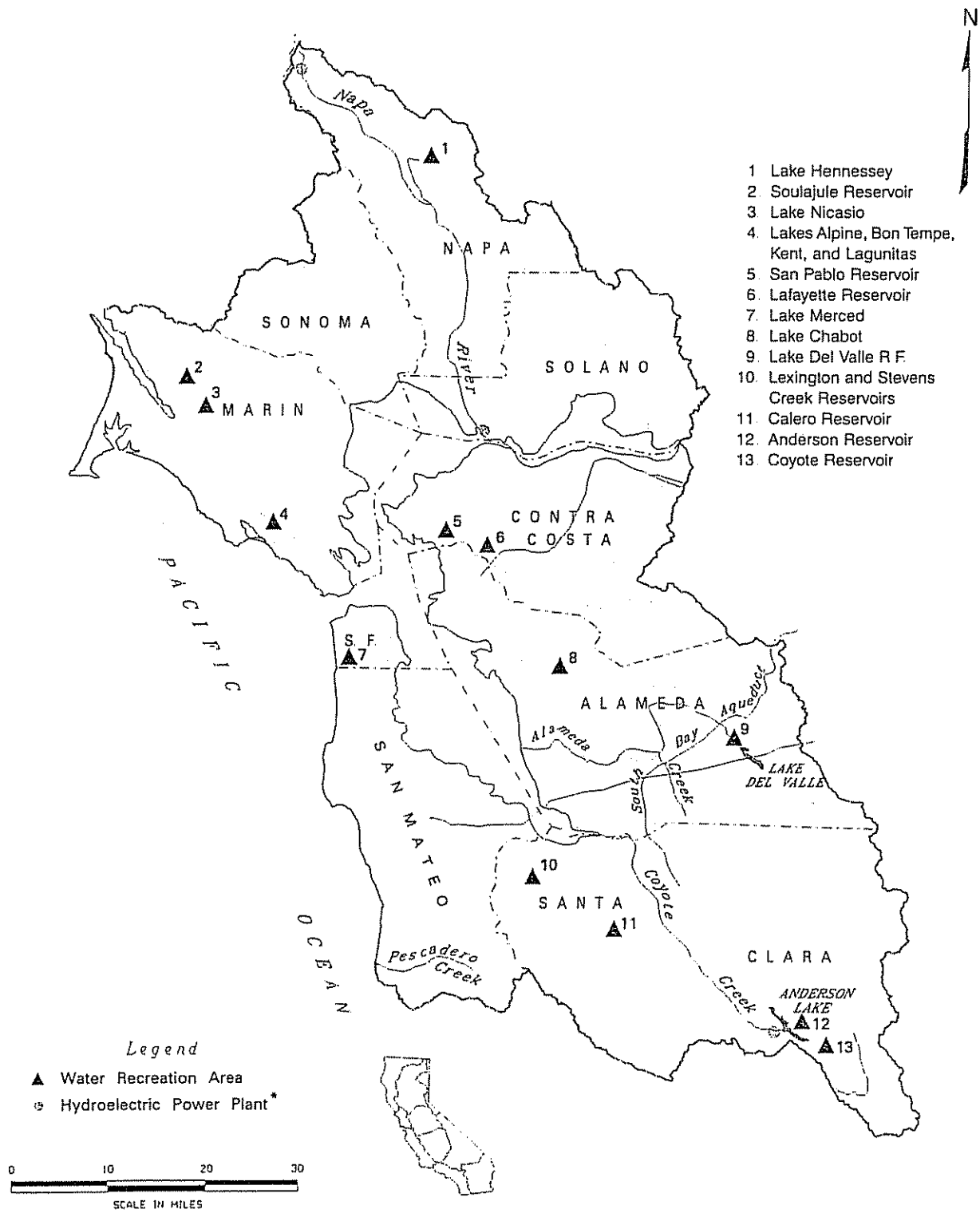
The principal water management issues facing the region are population growth and environmental concerns. The following paragraphs describe legislation, litigation, and issues affecting the region.

Legislation and Litigation

EBMUD Supplies. The SWRCB held hearings in November 1992 regarding instream flow requirements for the Mokelumne River. The Department of Fish and Game, private fishing groups, and environmental interest groups want to increase flows below Camanche Reservoir to protect the river's fishery. In addition, several water agencies in the Sierra foothills, San Joaquin County, and the Delta contend that they should receive some priority in the distribution of Mokelumne River water. If the SWRCB rules against EBMUD, the district could be forced to take a large portion of its water from the Delta rather than through the Mokelumne Aqueducts. Lower quality water from the Delta would mean increased treatment costs which would be passed on

Figure SF-6. San Francisco Bay Region

Hydroelectric Power Plants and Water Recreation Areas



*From 1992 California Energy Commission Maps See Table D-3 in Appendix D for plant information

to EBMUD customers. In a separate process, the Federal Energy Regulatory Commission is reviewing the district's hydropower operations. In November 1993, FERC issued a final EIS which recommends fish flows significantly greater than the district's Lower Mokelumne River Management Plan. The district filed a motion for a technical conference to provide additional information which the district believes should be the basis for revision of FERC's final decision. Final settlement is expected in 1994.

EBMUD diverted its contracted American River water only once, during the 1976-77 drought, when the district took 25,000 af from the Delta to supplement its depleted supplies under an emergency agreement with USBR. In 1972, a suit was filed protesting EBMUD's right to divert water at Folsom South Canal. In 1986, the SWRCB affirmed the right and referred the lawsuit to Alameda Superior Court for litigation. A preliminary decision in 1989 confirmed the right to divert water at Folsom South Canal and established minimum flows for the American River below Nimbus Dam that would be required before EBMUD could divert its supplies. A final decision was made in 1990, which cleared the way for the district to seriously consider a connection between the canal and the Mokelumne Aqueducts. An EIS/EIR will focus on technical, public health and safety, social, and environmental factors for the project. EBMUD, Sacramento County, Environmental Defense Fund, and DFG are cooperatively conducting fishery studies on the American River.

Recently EBMUD filed a lawsuit against Contra Costa County to block use of scarce EBMUD water for a housing development. The county certified an EIR for the Dougherty Valley development despite the concerns about water supply expressed by the district. EBMUD told the county that it does not have the water to supply the proposed 11,000-home development.

CVPIA. Implementation of the 1992 CVPIA will have some cost impacts on Bay Area water users in the form of higher prices for CVP water. The Act allocates a portion of CVP water to environmental uses and allows municipal and industrial users to purchase water from agricultural users. (See Volume I, Chapter 2.)

Local Issues

Slow-growth Movement. Anti-growth sentiment is increasing in some Bay Area communities as was evident during many of the 1992 local elections. Napa and Contra Costa counties elected several slow-growth candidates. Marin County residents had opposed efforts to improve their water system delivery capabilities beyond limited expansion of local supplies, fearful that more water would mean uncontrolled growth. The Marin Municipal Water District has had for the last three years a moratorium on new connections within its service area due to limited water supplies. The operational yield of present district facilities indicated a 5,000 af deficit for 1990. After more than 20 years of consistently rejecting plans to import more surface water, voters narrowly approved financing to increase the district's capacity to import water from the Sonoma County Water Agency in order to reduce the frequency and severity of drought year shortages.

Contra Costa Water District. The quality and reliability of CCWD's Delta water supply has been an issue for the district. The proposal to build Los Vaqueros Reservoir addresses a number of related issues for the district's water supply and the Delta. The proposed reservoir would be an offstream storage facility and would allow more flexibility in CCWD's operations. Specifically, the district could divert higher quality water to Los Vaqueros Reservoir during high flows in the Delta. Los Vaqueros water would then be available to improve water quality by blending with water delivered

throughout the year from the Delta and to provide emergency storage. By storing water at certain times of the year, the district could shut down its pumps during periods when the fisheries are most sensitive to large diversions. CCWD is planning to have the project online by 2000.

Lagunitas Creek. The SWRCB has not established permanent instream flow requirements below Peters Dam on Lagunitas Creek. Interim regulations require an average of 4,000 af annually to preserve or enhance the anadromous fishery of the creek. Significant changes in the permanent requirements would reduce Marin MWD's operational yield.

Drinking Water Standards. The California Department of Health Services is rewriting its surface water treatment requirements to comply with the Environmental Protection Agency's new drinking water standards. SFWD was recently given an extension of its operating permit to propose specific plans to meet DHS requirements. SFWD estimates that new facilities for treating Hetch Hetchy supplies, if required, could cost about $50 million.

Water Balance

Water budgets were computed for each planning subarea in the San Francisco Bay Region by comparing existing and future water demand forecasts with the forecasted availability of supply. The region total was computed by summing the demand and supply totals for all the planning subareas. This method does not reflect the severity of drought year shortages in some local areas which can be hidden when planning subareas are combined within the region. Thus, there could be substantial shortages in some areas during drought periods. Local and regional shortages could also be more or less severe than the shortage shown, depending on how supplies are allocated within the region, a particular water agency's ability to participate in water transfers or demand management programs (including land fallowing or emergency allocation programs), and the overall level of reliability deemed necessary to the sustained economic health of the region. Volume I, Chapter 11 presents a broader discussion of demand management options.

Table SF-12 presents water demands for the 1990 level and for future water demands to 2020 and compares them with: (1) supplies from existing facilities and water management programs, and (2) future demand management and water supply management options. Regional net water demands for the 1990 level of development totaled 6,071,000 and 4,652,000 af for average and drought years, respectively. Those demands are forecasted to increase to 6,296,000 and 4,895,000 af, respectively, by the year 2020, after accounting for a 250,000-af reduction in urban water demand resulting from additional long-term water conservation measures.

Urban net water demand is forecasted to increase by 470,000 af by 2020, without additional long-term water conservation measures, primarily due to expected increases in population, while agricultural net water demand remains essentially level. Environmental net water demands under SWRCB D-1485 would remain the same but could increase substantially depending on the outcome of several actions currently being undertaken to protect aquatic species.

Average annual supplies with existing water management programs are inadequate to meet average net water demands in this region, resulting in a shortage of about 30,000 af by 2020. During droughts, without additional water management programs, annual drought year shortages are expected to increase to about 484,000 af by 2020.

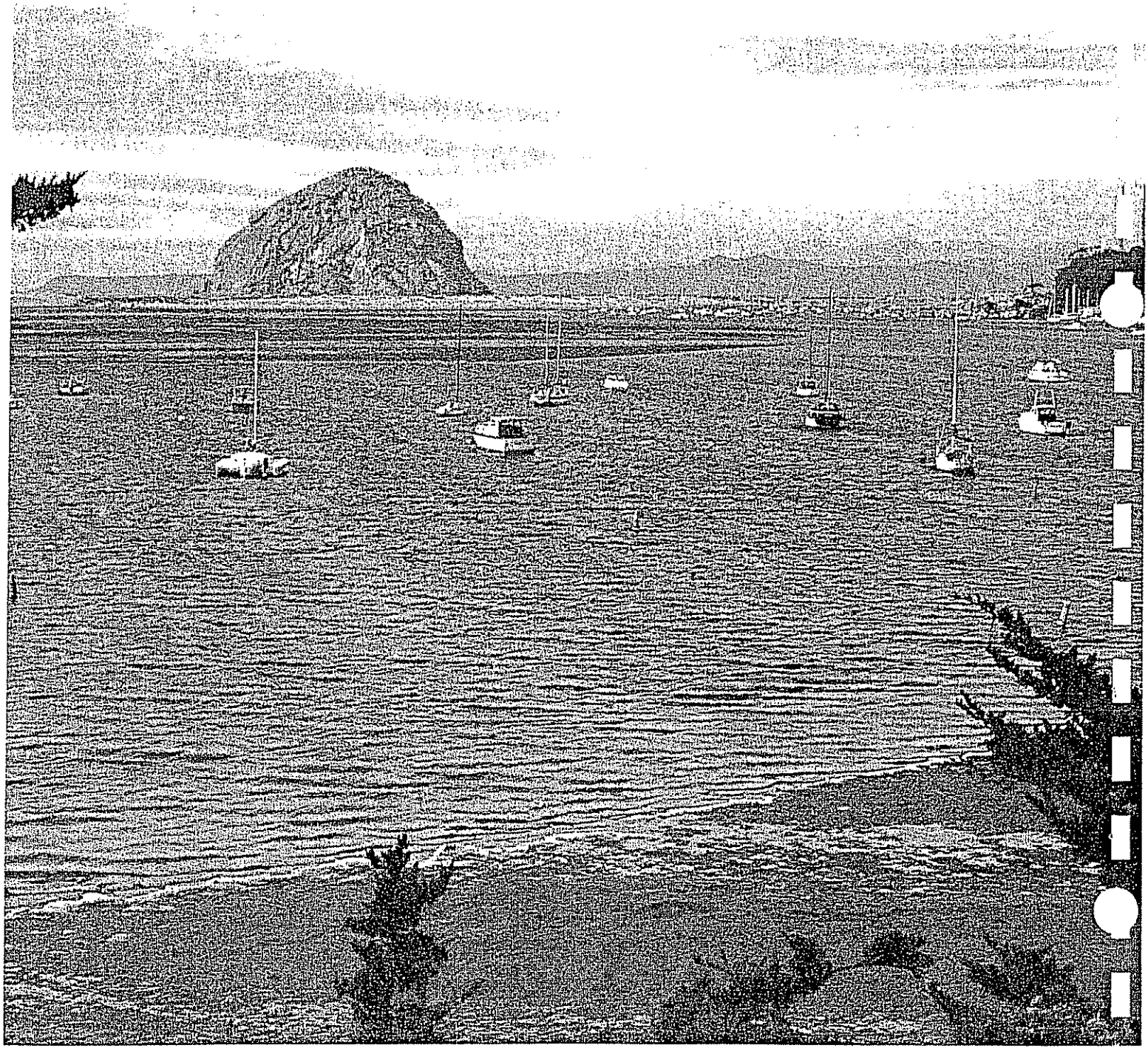
Table SF-12. Water Budget
(thousands of acre-feet)

Water Demand/Supply	*1990*		*2000*		*2010*		*2020*	
	average	*drought*	*average*	*drought*	*average*	*drought*	*average*	*drought*
Net Demand								
Urban—with 1990 level of conservation	1,186	1,287	1,409	1,501	1,559	1,680	1,656	1,780
—reductions due to long-term conservation measures (Level I)	—	—	-111	-111	-194	-194	-250	-250
Agricultural—with 1990 level of conservation	88	99	90	100	90	100	90	99
—reductions due to long-term conservation measures (Level I)	—	—	0	0	0	0	0	0
Environmental	4,775	3,245	4,775	3,245	4,775	3,245	4,775	3,245
Other[1]	22	21	22	21	23	21	25	21
TOTAL Net Demand	6,071	4,652	6,185	4,756	6,253	4,852	6,296	4,895
Water Supplies w/Existing Facilities Under D-1485 for Delta Supplies								
Developed Supplies								
Surface Water[2]	1,356	1,120	1,444	1,156	1,478	1,151	1,486	1,152
Ground Water	100	139	126	174	160	174	165	174
Ground Water Overdraft[3]	0	0	—	—	—	—	—	—
Subtotal	1,456	1,259	1,570	1,330	1,638	1,325	1,651	1,326
Dedicated Natural Flow	4,615	3,085	4,615	3,085	4,615	3,085	4,615	3,085
TOTAL Water Supplies	6,071	4,344	6,185	4,415	6,253	4,410	6,266	4,411
Demand/Supply Balance	0	-308	0	-341	0	-442	-30	-484
Level I Water Management Programs[4]								
Long-term Supply Augmentation								
Reclaimed	—	—	38	38	75	75	83	83
Local	—	—	0	43	0	43	0	43
Central Valley Project/ Other Federal	—	—	0	0	0	0	0	0
State Water Project	—	—	7	4	4	79	8	79
Subtotal - Level I Water Management Programs	0	0	45	85	79	197	91	205
Net Ground Water or Surface Water Use Reduction Resulting from Level I Programs	—	—	-45	14	-79	14	-61	18
Remaining Demand/Supply Balance Requiring Short-term Drought Management and/or Level II Options	0	-308	0	-242	0	-231	0	-261

(1) Includes major conveyance facility losses, recreation uses, and energy production.
(2) Existing and future imported supplies that depend on Delta export capabilities are based on SWRCB D-1485 and do not take into account recent actions to protect aquatic species. As such, regional water supply shortages are understated(note: proposed environmental water demands of 1 to 3 MAF are included in the California water budget)
(3) The degree future shortages are met by increased overdraft is unknown. Since overdraft is not sustainable, it is not included as a future supply.
(4) Protection of fish and wildlife and a long-term solution to complex Delta problems will determine the feasibility of several water supply augmentation proposals and their water supply benefits.

With Level I water management programs, supplies would meet the future water demand of the region in average years. However, during droughts, shortages could be reduced to about 261,000 af per year by 2020. This remaining shortage requires both additional short-term drought management, water transfers and demand management programs, and future Level II water management programs, depending on the overall level of water service reliability deemed necessary by local agencies. This region depends on export from the Sacramento-San Joaquin Delta for a portion of its supplies. Shortages stated above are based on SWRCB D-1485 operating criteria for Delta supplies and do not take into account recent actions to protect aquatic species in the estuary. As such, regional water supply shortages are understated

Morro Rock provides a stunning backdrop for these boats anchored in Morro Bay. Morro Bay is a popular community on the Central Coast whose primary industries are commercial ocean fishing and tourism.



Central Coast Region

The Central Coast Region accounts for about 7 percent of California's total land area. It encompasses the area adjacent to the Pacific Ocean including Santa Cruz County in the north through Santa Barbara County in the south to the Diablo and Temblor mountain ranges on the east. Its topographic features include Monterey and Morro Bay; the Pajaro, Carmel, Santa Maria, Cuyama, and Salinas valleys; and a number of mountain ranges. The Central Coast Region is best known for its rugged Pacific coastline, scenic bays, and redwood forests.

The varied geography of the region creates diverse climates. During the summer months, temperatures are generally cool along the coastline and warm inland. In the winter, temperatures remain cool along the coast and become even cooler inland.

Annual precipitation in the region ranges from 14 to 45 inches, usually in the form of rain. The average annual precipitation near the City of Salinas is about 14 inches while in the higher elevations of the Big Sur area, approximately 30 miles south of Monterey along the coast, precipitation averages about 40 inches a year. In 1983, the Big Sur area had a surprising 85 inches of rain. Average annual precipitation in the southern coastal basins ranges from 12 to 20 inches, with most of it occurring from November through April. The southern interior basins usually receive 5 to 10 inches per year, the mountain areas receiving more than the valley floors.

Population

With a 1990 population slightly under 1.3 million, the Central Coast Region contains roughly 4 percent of California's population. While most of California experienced a substantial population increase over the past 10 years, growth in this region exceeded the State's average. The collective population of incorporated cities in the Salinas Valley increased 37 percent during the past decade. Population centers along the coast, such as San Luis Obispo and Santa Maria, also had large population increases of 23 and 54 percent, respectively. In addition, significant increases were recorded in the Santa Ynez Valley and smaller communities in Salinas Valley. An inviting atmosphere of good weather, clean air, and close proximity to the mountains and urbanized areas encouraged this growth. However, building moratoriums limited population growth in the area near Santa Barbara.

Region Characteristics

Average Annual Precipitation: 20 inches *Average Annual Runoff: 2,477,000 af*

Land Area: 11,280 square miles *1990 Population:* 1,292,900

Population growth in the northern part of the region is also associated with space availability and affordable housing prices. While above the national average, the cost of homes in this area is affordable compared to many other parts of California. Much of the region's growth is the result of people migrating from the San Francisco Bay and Los Angeles areas. Current growth in the region's northern area is primarily in and around Hollister, Salinas, and the Watsonville area. Table CC-1 shows population projections to 2020 for the region.

Table CC-1. Population Projections
(thousands)

Planning Subarea	*1990*	*2000*	*2010*	*2020*
Northern	702	823	969	1,129
Southern	591	699	792	888
TOTAL	1,293	1,522	1,761	2,017

Despite the population increases, much of the region is sparsely populated. The principal population centers are Santa Cruz, Salinas, Watsonville, Monterey, San Luis Obispo, Santa Maria, Santa Barbara and Lompoc. Most of the region's future population growth continues to be in areas showing recent growth.

The economy in many areas of the region is tied to military installations. Fort Ord, Hunter-Liggett Military Reservation, Camp Roberts, and Vandenberg AFB are the major military facilities in the region. The Monterey Peninsula area is now preparing for the closure of Fort Ord. The cities of Seaside and Marina will suffer the greatest impacts, but the entire area is expected to be affected by the loss of military personnel, civilian workers, and their families.

Land Use

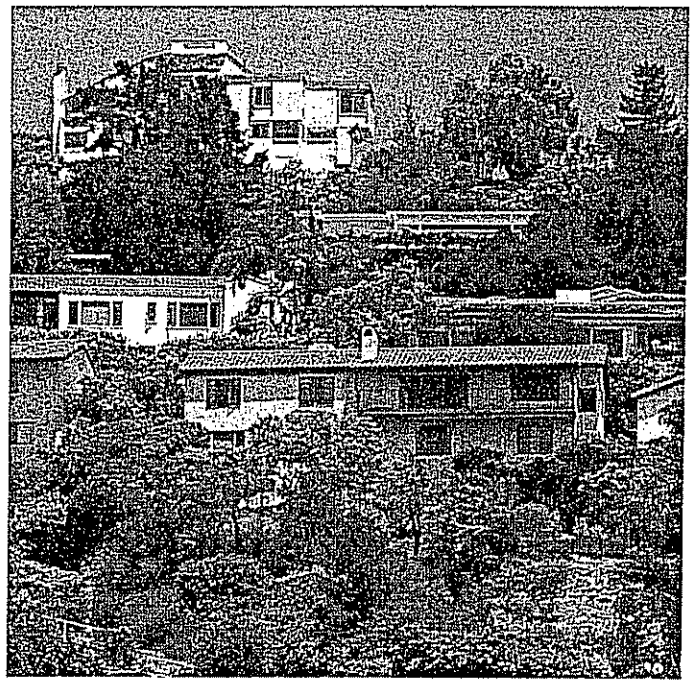
Publicly-owned lands constitute approximately 28 percent of the region's area. The four major military installations within the region occupy 340,000 acres. (See Appendix C for maps of the planning subareas and land ownership in the region.) The abundance of state parks and national forest land (Los Padres, 1.3 million acres) offers the public many recreational opportunities. Elkhorn Slough National Estuarine Research Reserve, one of the few remaining coastal wetlands, showcases miles of scenic wetlands and rolling hills. The slough is on a migratory flyway and is an important feeding and resting ground for a variety of waterfowl. Irrigated and nonirrigated agriculture still remains the dominant land use for most of the Central Coast region. Intensive agriculture exists in the Salinas and Pajaro valleys in the north and the Santa Maria and lower Santa Ynez valleys in the south. Moderate levels of agricultural activity also occur near the Upper Salinas, South Coast, and Cuyama areas. Most of the region's irrigated agriculture is in the northern and southwestern valleys, and in recent years irrigated acreage has remained fairly stable. Figure CC-1 shows land use, along with imports and exports for the Central Coast Region.

Wine grape acreage has increased in the upper Salinas Valley in San Luis Obispo County but decreased in the lower valley within Monterey County. However, acreage planted to vegetables and other truck crops far surpassed that planted to vineyards and orchards. Cut flowers, strawberries, and specialty crops, such as asparagus, mushroom, artichokes, and holly, are distinctive to the region's northern area. The flower seed industry in Lompoc Valley is a thriving business which also attracts many

tourists each year. Portions of the upper Salinas Valley and Carrizo Plain are dry-farmed to produce winter grain. These areas also support sheep and cattle ranching. Industries other than agriculture are not well developed, but there are petroleum refining operations near Santa Maria and a significant oil well field in the Cuyama Valley, as well as frozen food plants in the Pajaro Valley.

Urban development is beginning to encroach on the agricultural lands in the highly productive inland valleys. Total irrigated agricultural land acreage in the Central Coast Region decreased from 459,000 acres in 1980 to 430,000 acres in 1990 (-6 percent). Total crop acreage decreased from 531,000 acres in 1980 to 528,000 acres in 1990. Although the Southern PSA total irrigated land decreased from 156,000 acres to about 145,000 acres, total crop acres increased from about 155,000 acres in 1980 to about 182,000 acres in 1990. This indicated an increase in multiple cropping. Urban acreage also increased from 182,000 acres to 240,100 acres during the same period.

Increases in defense-related jobs associated with the space shuttle and missile testing programs at Vandenburg Air Force Base accelerated the urbanization of the Santa Maria and lower Santa Ynez valleys during the 1970s. Growth was experienced in all areas of urban land use, but primarily in the residential and industrial categories. Some agricultural land was lost to the initial wave of development. However, some local growers have compensated for the agricultural land losses by multiple croppings and use of nonirrigated pasture lands.



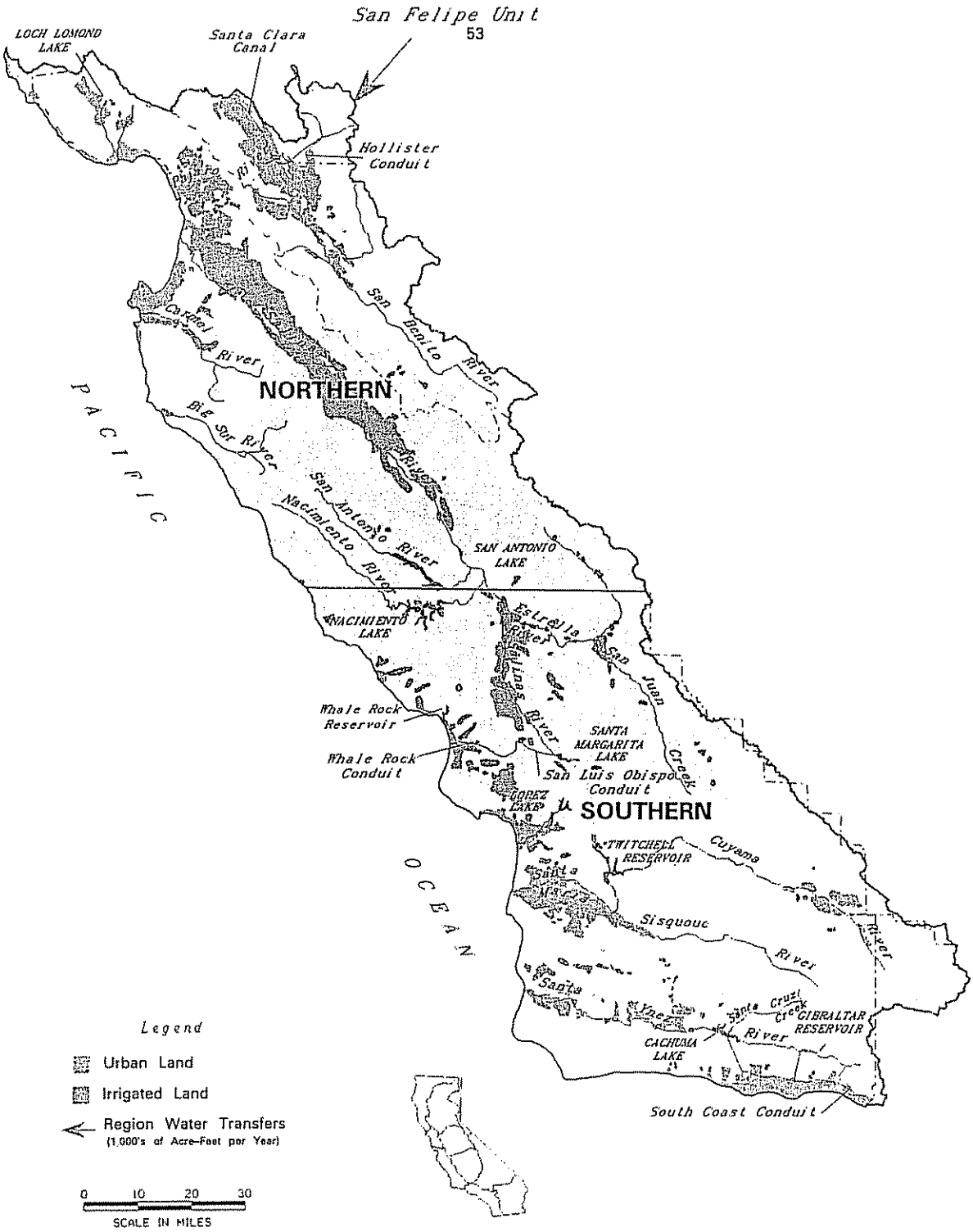
Houses nestled in the Santa Barbara hillside. Adequate water supplies to serve the area's growing urban population is an important issue facing the region.

Much of the coastal strip has not been developed because of steep slopes, inaccessibility, and military-use restrictions. Developed coastal areas consist primarily of tourist and resort areas (Monterey Bay, Cambria, Morro Bay, and Pismo Beach) and middle-to-upper-income residential communities (Carmel, Lompoc, Goleta, and Santa Barbara).

Water Supply

Ground water is the most significant source of water supply for the region. Imported supplies account for only 5 percent of the total. Completion of the Coastal Branch of the State Water Project, as well as other local projects, will lessen the reliance on ground water supplies. Figure CC-2 shows the region's 1990 level sources of supply.

Figure CC-1. Central Coast Region
Land Use, Imports, and Exports



The average water supply for the Central Coast Region for the 1990 level of development is estimated at 1,143,000 af. In 1990, ground water pumping amounted to 82 percent of total supplies, 21 percent of which was in excess of the estimated prime supply and is considered overdraft.

Supply with Existing Facilities and Water Management Programs

There are in excess of 60 reservoirs within the Central Coast Region, the majority of which are owned by private concerns. The reservoirs in the region are used for residential and municipal water needs, flood control, recreation, irrigation, and riparian habitat. The major reservoirs in the region are listed in Table CC-2.

Table CC-2. Major Reservoirs

Reservoir Name	*River*	*Capacity (1,000 AF)*	*Owner*
Santa Margarita Lake	Salinas	24	US Army Corps of Engineers
San Antonio	San Antonio	335	MCWRA
Nacimiento	Nacimiento	340	MCWRA
Gibralter	Santa Ynez	9	City of Santa Barbara
Cachuma (Bradbury)	Santa Ynez	190	U.S. Bureau of Reclamation
Whale Rock	Old Creek	41	Department of Water Resources
Lopez	Arroyo Grande Creek	52	SLOCFCWCD
Vaquero (Twitchell)	Cuyama River	240	U.S. Bureau of Reclamation

In the Northern PSA, ground water is the primary source of water for both urban and agricultural use. The Carmel, Pajaro, and Salinas rivers provide most of the ground water recharge for the area. The San Antonio and Nacimiento reservoirs regulate the Salinas River. Table CC-3 shows water supplies with existing facilities and water management programs.

Basins in the Southern PSA are smaller, but important to their local communities. These shallow basins underlie seasonal coastal streams. During years with normal or above-normal rainfall, aquifers in the basins are continuously replenished by creek flows. In years of below-normal precipitation, the creek flows are intermittent, flow is insufficient for both agricultural and municipal uses, wells become dry, and sea water intrudes into some coastal ground water basins.

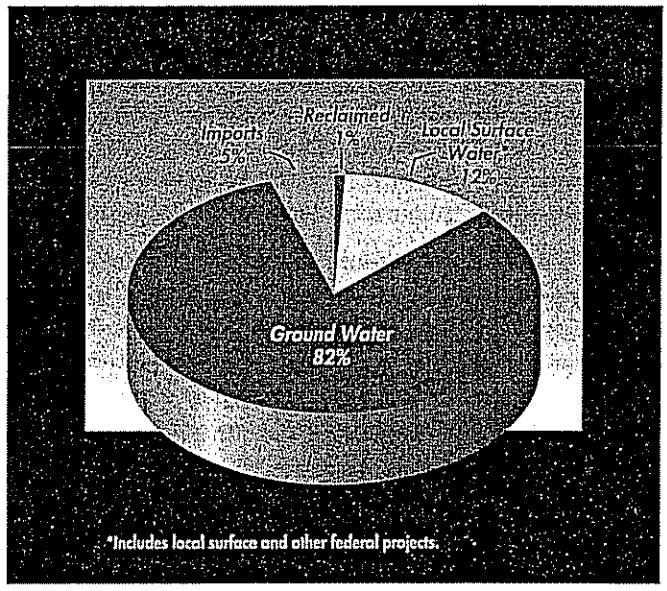


Figure CC-2. Central Coast Region Water Supply Sources (1990 Level Average Conditions)

Table CC-3. Water Supplies with Existing Facilities and Programs
(Decision 1485 Operating Criteria for Delta Supplies)
(thousands of acre-feet)

Supply	*1990*		*2000*		*2010*		*2020*	
	average	*drought*	*average*	*drought*	*average*	*drought*	*average*	*drought*
Surface								
Local	76	56	76	56	76	56	76	56
Local imports	0	0	0	0	0	0	0	0
Colorado River	0	0	0	0	0	0	0	0
CVP	53	19	56	19	80	23	83	23
Other federal	65	46	65	46	65	46	65	46
SWP	0	0	0	0	0	0	0	0
Ground water[1]	688	762	694	769	695	776	698	781
Overdraft[2]	245	245	—	—	—	—	—	—
Reclaimed	15	15	23	23	23	23	23	23
Dedicated natural flow	1	0	1	0	1	0	1	0
TOTAL	1,143	1,143	915	913	940	924	946	929

(1) Average ground water use is prime supply of ground water basins and does not include use of ground water which is artificially recharged from surface sources into the ground water basins.
(2) The degree future shortages are met by increased overdraft is unknown. Since overdraft is not sustainable, it is not included as a future supply

Water Supply Reliability and Drought Management Strategies. Many large and small communities in the region have initiated both voluntary and mandatory water conservation practices. Practices range from voluntary water conservation and limited outdoor watering to mandatory water rationing and little or no outdoor watering. The City of Salinas relies on outdoor watering restrictions based upon time-of-day water use limitation, and voluntary water conservation practices. Recently, many of the communities which mandated water rationing during the drought have elected to implement a voluntary water conservation program. For example, Monterey has an outdoor watering schedule based upon time-of-day restrictions, and the city's water waste ordinance is still in effect. The communities of Watsonville and Santa Cruz have voluntary water conservation programs in place. Water runoff from overwatering is prohibited in these communities.

The Marina County Water District in Monterey County, near Fort Ord, has stepped up its conservation efforts to deal with the issue of drought and sea water intrusion. In 1991, the Marina County Water District adopted an ordinance designed to prohibit water waste and encourage conservation efforts. Water conservation projects initiated included a low-flow showerhead retrofit program, resulting in the replacement of one-third of all showerheads in the district. A water audit program was also initiated to provide owners of both businesses and residences with a personalized water conservation plan.

Water supply shortages occurred in the South Coast, San Luis Obispo, Morro Bay, and North Coast areas of the region because of the 1987-92 drought in the Central Coast Region. Dwindling surface water supplies forced retail water agencies in these areas to depend more on limited ground water supplies and water conservation to make up deficits. Portions of the Southern PSA experienced unprecedented supply shortages. In the summer of 1990, retail water agencies in the service area of Lake

Cachuma were confronted with the prospect that only 12 months of supply remained in that reservoir Two of these agencies were the Goleta Water District and the City of Santa Barbara The Goleta Water District began implementing a mandatory water rationing program in 1988 for all urban and agricultural customers within its service area The historical water use by all customers was evaluated and a percentage reduction was assigned to each; financial penalties were established to prevent noncompliance In addition the agency established a rebate program that involved the purchase and installation of ultra-low-flush toilets for residential customers, passed ordinances that temporarily banned certain water-related activities, and vigorously advertised water conservation The conservation efforts by retail customers exceeded the savings levels imposed by the district and resulted in extra water supplies being delivered to agricultural customers

The City of Santa Barbara implemented similar strategies in combating supply shortages The city also established a drought patrol to monitor water use behavior, and penalties and citations were handed out to violators In addition, the city examined and approved action to: 1) import emergency SWP water from Ventura County and 2) examine the potential of sea water desalination An emergency pipeline was installed to bring SWP water into the Santa Barbara-Carpenteria area from Casitas Lake in Ventura County by exchange, and a sea water desalination plant was constructed in 1991-92 that is capable of producing 7,500 af per year The plant operated until early June 1992, when it was shut down; the plant will remain on stand-by mode due to plentiful surface supplies The cost to produce the water was relatively high for an area that relies on existing local surface supplies and ground water

To minimize the impacts of the drought, the City of Morro Bay operated a sea water desalting plant with a capacity of 400 gallons per minute This plant is operated under an emergency-only permit (drought emergency) The city has applied to the California Coastal Commission for a permit to use the plant on an as-needed basis

During the height of the drought, the counties of San Luis Obispo and Santa Barbara relaxed certain health restrictions on the use of gray water for residential landscape irrigation Homeowners in San Luis Obispo County were permitted to use secondary washing machine rinse water for irrigation but were required to discharge the water underground

In Santa Barbara, irrigation with grey water was permitted on nonedible plant materials only and homeowners were required to discharge the water through drip systems or leach lines Regulations on the grey water use were not relaxed in other parts of the region

Supply with Additional Facilities and Water Management Programs

Future water management options are presented in two levels to better reflect the status of investigations required to implement them

- Level I options are those programs that have undergone extensive investigation and environmental analyses and are judged to have a high likelihood of being implemented by 2020
- Level II options are those programs that could fill the remaining gap between water supply and demand These options require more investigation and alternative analyses

Increased use of SWP water in the Southern PSA and CVP water in the Northern PSA will require additional transportation facilities As outlined in the water supply section, many agencies are looking to these import sources for their future supplies

Local alternatives being examined include increasing capacity in local storage reservoirs or, in some cases, authorizing new projects. Cloud seeding and desalination are showing to be effective in parts of the region. The following sections summarize water management programs under active consideration in the region.

To improve the reliability of water supplies in the Monterey Bay area, the Monterey Peninsula Water Management District has taken a number of actions including water conservation, water reclamation, and investigating several water development alternatives. Improvements to the system also are needed to provide water for municipal and industrial as well as environmental needs of the area. Current supply is inadequate during drought years when shortages develop due to lack of adequate storage facilities. The Monterey Peninsula Water Management District investigated 32 water supply alternatives before selecting five alternatives for final analysis. The preferred environmentally superior alternative is the 24,000-af New Los Padres Reservoir, with or without desalination. The New Los Padres Dam would be on the Carmel River and would completely inundate the existing dam and reservoir. The New Los Padres Reservoir could provide 22,000 af of supply in an average year to the Monterey Peninsula's water supply system.

Table CC-4. Water Supplies with Level I Water Management Programs

(Decision 1485 Operating Criteria for Delta Supplies)

(thousands of acre-feet)

Supply	*1990*		*2000*		*2010*		*2020*	
	average	*drought*	*average*	*drought*	*average*	*drought*	*average*	*drought*
Surface								
Local	76	56	100	78	100	78	100	78
Local imports	0	0	0	0	0	0	0	0
Colorado River	0	0	0	0	0	0	0	0
CVP	53	19	56	19	100	30	103	30
Other federal	65	46	65	46	65	46	65	46
SWP	0	0	53	25	53	43	53	43
Ground water[1]	688	762	678	768	682	775	686	780
Overdraft[2]	245	245	—	—	—	—	—	—
Reclaimed	15	15	67	67	78	78	78	78
Dedicated natural flow	1	0	17	6	17	6	17	6
TOTAL	1,143	1,143	1,036	1,009	1,095	1,056	1,102	1,061

(1) Average ground water use is prime supply of ground water basins and does not include use of ground water which is artificially recharged from surface sources into the ground water basins.
(2) The degree future shortages are met by increased overdraft is unknown. Since overdraft is not sustainable, it is not included as a future supply.

Many areas within the Southern PSA use local surface water projects and ground water extractions as their primary sources of water. Surface water storage facilities include Salinas Reservoir, Twitchell Reservoir, and Lake Cachuma. Annual precipitation and spring runoff from nearby mountains determine the reliability of these vital water supplies. In some instances, emergency measures, such as those in 1990 when local and SWP water from Ventura County was wheeled to Santa Barbara, must be implemented to ensure an adequate supply of water. In 1992, Santa Barbara and San Luis Obispo counties approved extending the Coastal Branch of the SWP.

which will increase their future water supply reliability Table CC-4 shows water supplies with additional Level I water management programs.

Agencies within San Luis Obispo County have requested 4,830 af from the SWP, while requests from Santa Barbara County total 42,486 af. Availability of SWP supplies in Santa Barbara and to a lesser degree San Luis Obispo counties will lessen the severity and frequency of water supply shortages and will help alleviate ground water overdraft. The County of San Luis Obispo is also negotiating to take delivery of its full entitlement of 17,500 af of Nacimiento Reservoir water by the year 2000.

The City of San Luis Obispo has actively been pursuing the Salinas Reservoir Expansion Project to supplement its water supply. The project involves installation of spillway gates to expand the storage capacity of the existing reservoir from about 23,840 af to 41,790 af. This project will increase the reservoir storage by about 17,950 af and increase the City annual supplies by about 1,650 af. The Environmental Impact Report for the project is expected to be certified in 1994.

The City of Lompoc has voted not to take its 4,000-af entitlement of SWP water and plans to negotiate for federal water from Lake Cachuma. Currently, Lake Cachuma water goes to residents in the Santa Barbara area and to the Santa Ynez River Water Conservation District.

Other measures to augment water supplies are under consideration by various water agencies. Cloud seeding has been effective in the Monterey County mountains. Desalination, reservoir enlargement, and importing surface water are options to increase surface water supplies. The USBR completed a study of the cost effectiveness of extending the San Felipe Project of the federal CVP, which would deliver water to the Pajaro Valley. Several local government and water agencies are preparing water management plans which will address short-, medium-, and long-term schemes to reduce water use and bring in additional water.

Water recycling will play an increasing role in supplies for nonconsumptive use. The Carmel Area Wastewater District will begin construction during 1993 of a water recycling project that will serve seven golf courses and two recreational areas in the Pebble Beach area of Monterey County. Plans call for enough recycled water to meet almost 100 percent of the users' irrigation demands. The project is being developed with the Pebble Beach Community Services District.

Water recycling facilities have been built by the City of Santa Barbara and by the Goleta Water District. The City recently completed Phase II of its project, bringing the total delivery capability of the City to about 1,200 af per year. Goleta Sanitary District and Goleta Water District have recently dedicated a desalination plant with a capacity of 2,300 gallons per minute.

The Monterey Regional Water Pollution Control Agency was formed in the 1970s to seek solutions to the problem of water pollution, and is comprised of a dozen local entities. During the late 1970s the MRWPCA began purchasing the treatment plants and outfalls owned by its member agencies. To comply with regulations of the SWRCB and the U.S. EPA, old outfalls were replaced by a large outfall discharging two miles offshore. The installation of interceptor pipelines and pump stations to divert waste water from Pacific Grove, and the upgrade of the Monterey Treatment Plant were completed in 1981. In 1983, a series of interceptor pipelines, pump stations, and a new ocean outfall were completed.

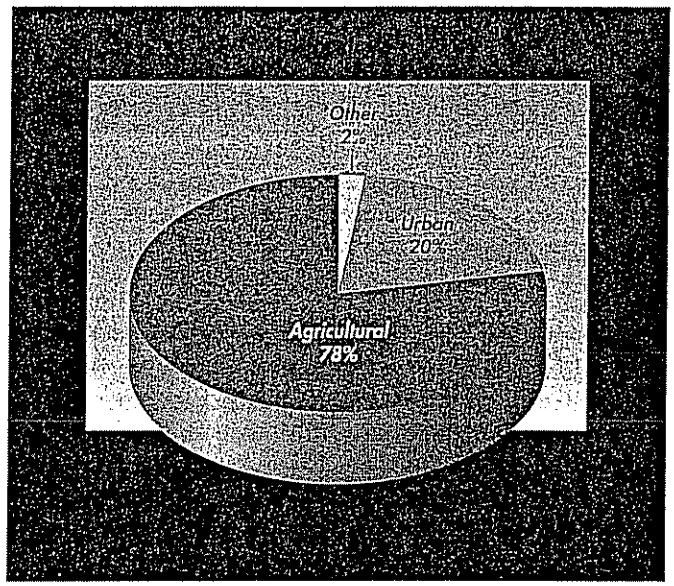
The Monterey County Water Resources Agency is in the process of screening nine major project alternatives, each with several components, to bring the Salinas Basin

into balance and reduce sea water intrusion. Some of the alternatives include enlarging the capacities of San Antonio and Nacimiento reservoirs, constructing a tunnel to transport water from Nacimiento to San Antonio, constructing dams on the Arroyo Seco River and Chalone Creek, and developing a dispersed well system and transportation system to convey water from south Monterey County to water deficient areas in north Monterey County

Water Use

In 1990, water use in the region was divided 60 and 40 percent between the Northern and Southern PSAs, respectively. Agricultural water use accounts for 78 percent of the region's total water use, while urban water use is 20 percent of the total. The remainder of the region's water use is for energy production, environmental needs, conveyance losses, and recreation. The 1990 level net water use in the region is about 1,143,000 af. Forecasts indicate that average annual water demand will increase about 13 percent to 1,291,000 af by 2020. Figure CC-3 shows net water demand for the 1990 level of development. The 1990 level drought demand is 1,213,000 af and is projected to increase to 1,379,000 by 2020

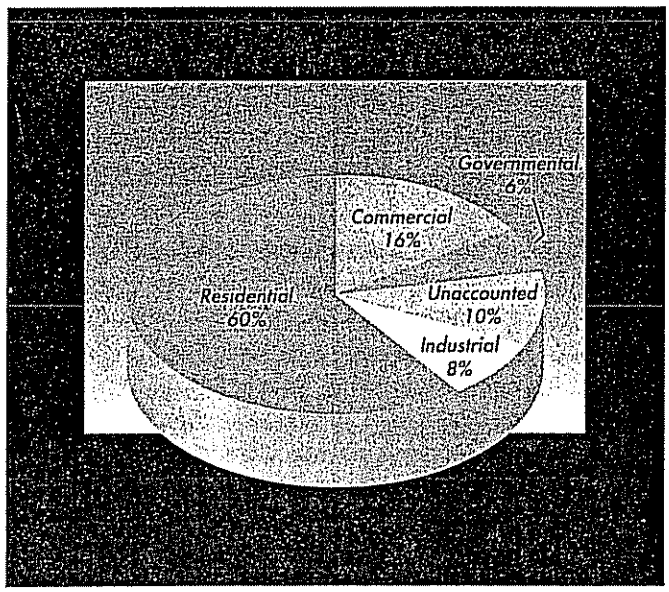
Figure CC-3
Central Coast Region
Net Water Demand
(1990 Level
Average Conditions)



Urban Water Use

Population in the Central Coast is expected to grow by about 56 percent by 2020 to over 2 million people. Figure CC-4 shows applied urban water demand, by sector, for the 1990 level of development. Table CC-5 shows urban water demand projections to 2020

Figure CC-4
Central Coast Region
Urban Applied Water
Use by Sector
(1990 Level
Average Conditions)



In the Southern PSA, average 1990 level per capita use for the San Luis Obispo and Santa Barbara

areas was 190 and 187 gallons, respectively. The per capita water use for the Southern PSA is 187 gallons, while that in the Upper Salinas Valley area, in the region's warmer interior, is 223 gallons.

In the Northern PSA, the average per capita use for the region is about 190 gallons per day. This value varied from a high of about 250 gallons per day in the warmer inland communities of Hollister and King City to a low of about 150 gallons per day in the chronically water-short Monterey-Carmel area.

With a few exceptions, most cities and metropolitan centers as well as predominant urban water demands in the region are geographically near U.S. Highway 101. Construction is primarily in the form of single-and multiple-family style housing units and commercial services. Even though demand has generally increased in the region, per capita water use values have not changed significantly. This is because: (1) higher water-using industries have not established themselves in areas with new construction and, (2) the number of multiple-family dwelling units built counterbalance the single-family units.

Table CC-5 projects the applied and net urban water use for the next 30 years. While the population is expected to increase 56 percent, the comparatively low per capita use rate in the areas where growth is expected, coupled with water-saving technologies employed in new developments, will not produce a proportional increase in water use for the region.

Table CC-5. Urban Water Demand
(thousands of acre-feet)

Planning Subarea	*1990*		*2000*		*2010*		*2020*	
	average	*drought*	*average*	*drought*	*average*	*drought*	*average*	*drought*
Northern								
Applied water demand	151	152	176	178	207	210	242	245
Net water demand	131	132	152	154	179	182	209	212
Depletion	118	118	137	138	160	162	187	189
Southern								
Applied water demand	122	125	139	143	158	163	178	184
Net water demand	98	101	111	114	125	129	140	145
Depletion	85	88	98	101	112	116	128	132
TOTAL								
Applied water demand	273	277	315	321	365	373	420	429
Net water demand	229	233	263	268	304	311	349	357
Depletion	203	206	235	239	272	278	315	321

Agricultural Water Use

Forecasts indicate that agricultural water use will increase, from the 1990 level, by 3 percent by 2020. Irrigated agriculture in the northern Central Coast Region has remained relatively stable during the past decade. Total agricultural land acreage has not changed significantly and total crop acreage has increased due to an increase in multiple cropping of vegetables in the Salinas Valley. There has been a slight shift away from permanent crops such as grapes and apples to annual crops. Acreage planted in strawberries, a very high-market value annual crop, has increased. Lettuce and other annual crops have also increased acreage since 1980. In the southern portion of the

region, irrigated agricultural acreage is forecasted to increase slightly by 2020. Although total irrigated land will gradually decrease, while planted and harvested crop acres will increase because of the: (1) intensification of multiple-cropping and (2) conversion of undeveloped and formerly nonirrigated lands to irrigable lands. Vineyards (primarily wine grapes) show the most significant acreage expansion. Truck crop and citrus and subtropical fruit orchard acres will remain relatively stable, while other crop categories will experience decreases. Table CC-6 shows irrigated acreage projections to 2020. Figure CC-5 shows the 1990 level irrigated acreage, ETAW, and applied water for major crops in the region.

Table CC-6. Irrigated Crop Acreage
(thousands of acres)

Planning Subarea	*1990*	*2000*	*2010*	*2020*
Northern	346	356	371	379
Southern	182	186	187	187
TOTAL	528	542	558	566

Despite the recent drought and continued long-term overdraft in some areas, agricultural water supplies have remained dependable. Virtually all applied irrigation water was pumped ground water until water from the CVP San Felipe Project was introduced into San Benito County in June 1987. Ground water still constitutes a large majority (82 percent) of the water supply; and, although not without its problems, such as sea water intrusion, the ready availability of ground water is important to the stability of this area. Irrigated crop acreage is expected to remain roughly stable with only a slight increase. Table CC-7 shows the 1990 level evapotranspiration of applied water by crop. Table CC-8 shows agricultural water demand projections to 2020.

Figure CC-5. 1990 Central Coast Region Acreage, ETAW, and Applied Water for Major Crops

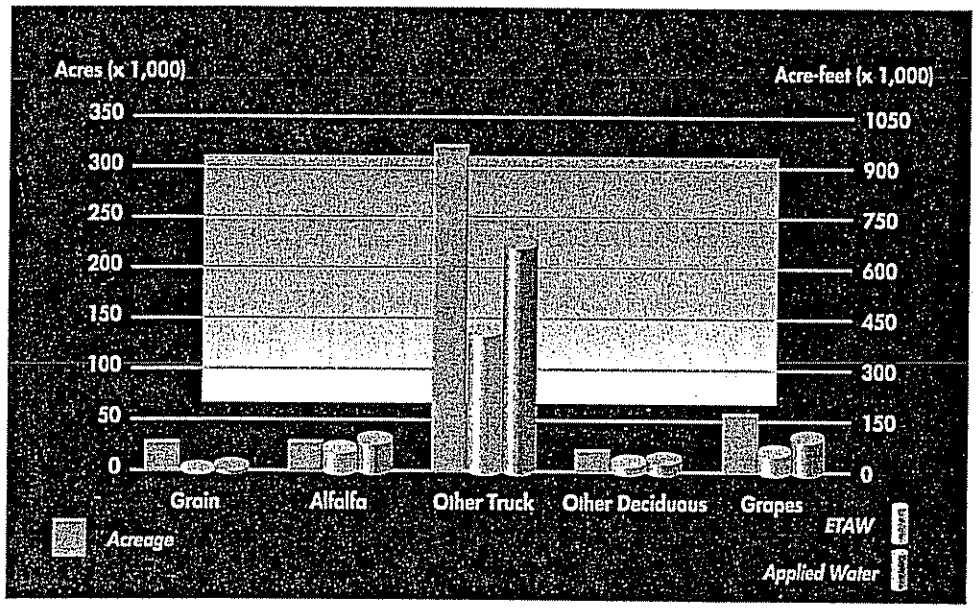


Table CC-7. 1990 Evapotranspiration of Applied Water by Crop

Irrigated Crop	*Total Acres (1,000)*	*Total ETAW (1,000 AF)*
Grain	28	5
Sugar beets	5	8
Corn	3	3
Other field	16	17
Alfalfa	27	68
Pasture	20	51
Tomatoes	14	21
Other truck	321	415
Other deciduous	20	28
Vineyard	56	61
Citrus/olives	18	27
TOTAL	528	704

About one-third of the wine grape acreage in the Salinas Valley has been converted to low-volume irrigation systems in recent years. There has also been a slight trend towards buried drip irrigation in vegetable crops in the same area. This trend is even more pronounced in San Benito County. About one-fourth of these plantings are currently using this method. In this same area the small acreage of new deciduous tree plantings are on low-volume systems. Water conservation measures implemented by growers for their irrigation operations are often related to operating-cost reductions. Drip, low-flow emitters, and sprinklers are used for many of the grape, citrus, and subtropical fruit orchards (vineyards are also retrofitted with overhead sprinklers for frost protection). Growers also use hand-moved sprinklers to meet pre-irrigation and seed germination requirements for most truck, corn, tomato, and some field crops; this is usually followed by furrow irrigation. Seedling transplants for some truck crops eliminate the need for seed germination irrigation.

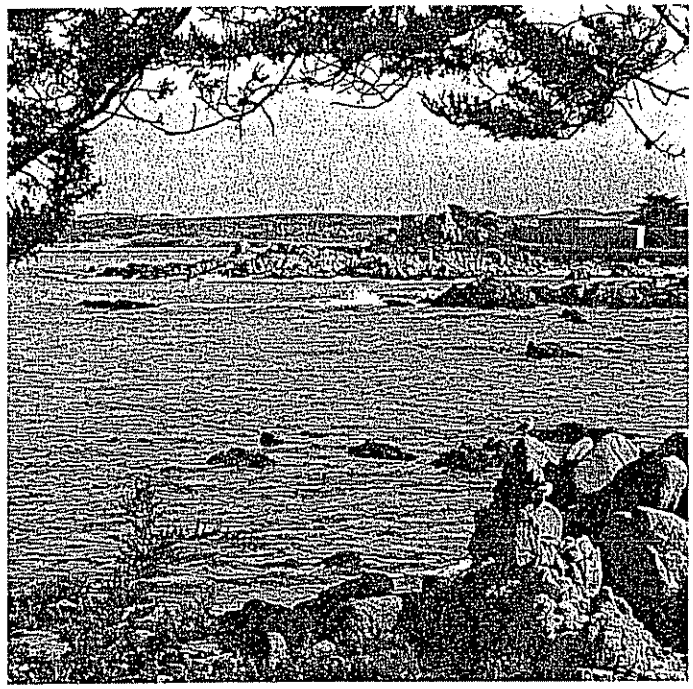
Rows of lettuce stretch out to the horizon in Salinas Valley. Irrigated crop acreage in the region is forecasted to increase only slightly.

Table CC-8. Agricultural Water Demand
(thousands of acre-feet)

Planning Subarea	*1990*		*2000*		*2010*		*2020*	
	average	*drought*	*average*	*drought*	*average*	*drought*	*average*	*drought*
Northern								
Applied water demand	705	711	735	742	766	773	781	787
Net water demand	551	594	569	615	587	634	593	647
Depletion	542	583	560	604	578	623	583	636
Southern								
Applied water demand	435	467	431	464	416	447	408	446
Net water demand	342	367	341	367	333	357	328	356
Depletion	342	367	341	367	333	357	328	356
TOTAL								
Applied water demand	1,140	1,178	1,166	1,206	1,182	1,220	1,189	1,233
Net water demand	893	961	910	982	920	991	921	1,003
Depletion	884	950	901	971	911	980	911	992

Environmental Water Use

The recent drought has created problems for the fish and wildlife in the region. Along the rivers, riparian habitat has diminished. Likewise, the lack of precipitation has weakened or killed trees and native vegetation in the foothill and mountain areas, creating potential fire problems, insect infestation, and disease.



Sea gulls sun themselves on rocks along the shore of Monterey Bay. The bay is home to the California sea otter, which is now enjoying a resurgence in its population.

The Carmel River, San Luis Obispo Creek, Santa Ynez River, and other coastal streams have historically been habitats for steelhead. However, steelhead migration has been reduced by dam construction, low flows due to surface water diversions, ground water pumping, poor water quality, and habitat degradation. A number of projects have been proposed for these systems, ranging from dam enlargements on the Carmel and Santa Ynez rivers to a water reclamation project on San Luis Obispo Creek. Environmental net water demand accounts for 1,000 af. Table CC-9 shows the total environmental instream water needs for the region.

In the Southern portion of the Central Coast Region, there are no federal or State wildlife refuges. To the north, Elkhorn Slough National Estuarine Research Reserve is a 1,340-acre coastal area which protects the habitat of many species of birds, fish, and invertebrates. The reserve is owned by the Department of Fish and Game. The slough is one of the few relatively undisturbed coastal wetlands remaining in California. It also serves as a feeding and resting ground for migratory fowl. The reserve receives no fresh water.

Table CC-9. Environmental Instream Water Needs
(thousands of acre-feet)

Stream	*1990*		*2000*		*2010*		*2020*	
	average	*drought*	*average*	*drought*	*average*	*drought*	*average*	*drought*
Carmel River								
Applied water demand	4	2	4	2	4	2	4	2
Net water demand	1	0	1	0	1	0	1	0
Depletion	1	0	1	0	1	0	1	0
TOTAL								
Applied water demand	4	2	4	2	4	2	4	2
Net water demand	1	0	1	0	1	0	1	0
Depletion	1	0	1	0	1	0	1	0

Other Water Use

Other water uses in the region include water for recreation and energy production. Water for recreation and energy is equivalent to roughly 1 percent of total demand for the region and is expected to remain about the same in coming years. Recreational opportunities in the region benefit from the many lakes, rivers, parks, and forests. Activities include hiking, swimming, fishing, boating, camping, and water skiing. Recreational water use accounted for over 1,000 af in 1990. There does not appear to be any additional future recreation water use prospects for the region. Surface water recreation is available at San Antonio, Nacimiento, Lopez Lake, Twitchell, and Lake Cachuma reservoirs, among others. Most offer fishing, boating, camping, and water skiing. Figure CC-6 shows water recreation areas in the region.

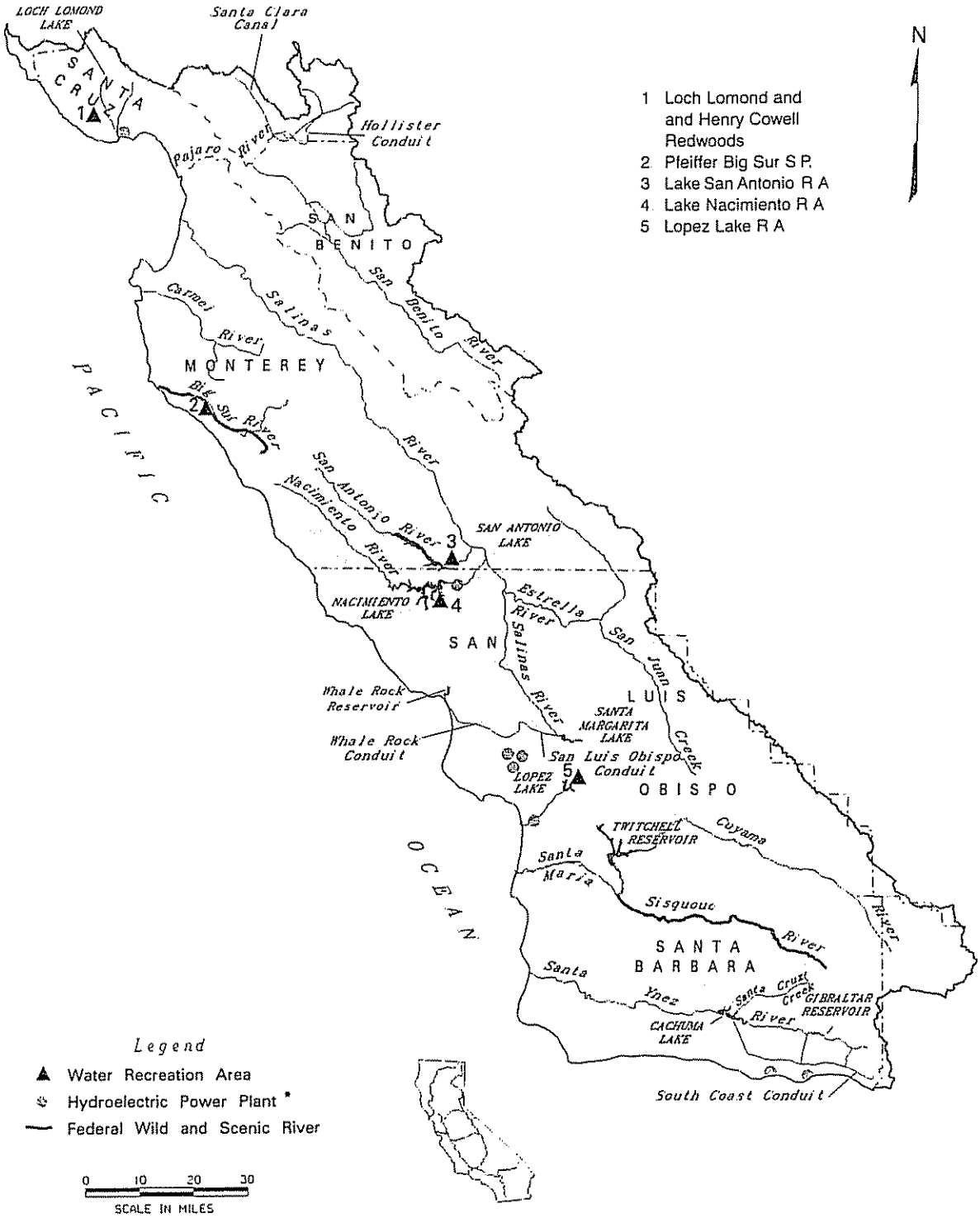
Cooling water is integral to the operations of electrical power plants (gas, oil, and nuclear). Many of the region's power plants are located along the coastline and use sea water for cooling. Injection of freshwater into the underground oil fields accounted for almost 14,000 af of water use in 1990 for the Santa Ynez area. Table CC-10 shows the total water demands for this region.

Issues Affecting Local Water Resource Management

The Central Coast Region, with its inland valleys and coastal ground water basins, presents diverse water management issues. With limited surface supply and few surface water storage facilities, the growing demand for water places an increased dependence on ground water pumping, which is necessary to meet the region's needs. As ground water extractions exceed ground water replenishment, many of the region's aquifers are experiencing overdraft conditions. This condition has allowed sea water to advance into some coastal freshwater aquifers. Sea water intrusion is a continuing threat to ground water reservoirs, and limits on ground water pumping and use are currently being discussed. The recent drought required many communities in the region to implement stringent water rationing programs. Unless additional water supplies are secured, the region will not be able to support existing water uses, let alone additional water users.

Figure CC-6. Central Coast Region

Hydroelectric Power Plants and Water Recreation Areas



*From 1992 California Energy Commission Maps See Table D-3 in Appendix D for plant information.

Table CC-10. Total Water Demands
(thousands of acre-feet)

Category of Use	1990		2000		2010		2020	
	average	drought	average	drought	average	drought	average	drought
Urban								
Applied water demand	273	277	315	321	365	373	420	429
Net water demand	229	233	263	268	304	311	349	357
Depletion	203	206	235	239	272	278	315	321
Agricultural								
Applied water demand	1,140	1,178	1,166	1,206	1,182	1,220	1,189	1,233
Net water demand	893	961	910	982	920	991	921	1,003
Depletion	884	950	901	971	911	980	911	992
Environmental								
Applied water demand	4	2	4	2	4	2	4	2
Net water demand	1	0	1	0	1	0	1	0
Depletion	1	0	1	0	1	0	1	0
Other[1]								
Applied water demand	17	18	17	18	17	18	17	18
Net water demand	20	19	20	19	20	19	20	19
Depletion	20	19	20	19	20	19	20	19
TOTAL								
Applied water demand	1,434	1,475	1,502	1,547	1,568	1,613	1,630	1,682
Net water demand	1,143	1,213	1,194	1,269	1,245	1,321	1,291	1,379
Depletion	1,108	1,175	1,157	1,229	1,204	1,277	1,247	1,332

(1) Includes major conveyance facility losses, recreation uses, and energy production.

Legislation and Litigation

Nacimiento Releases. Over the past several years, two lawsuits were filed seeking to control the water releases from Nacimiento Reservoir. The first one was filed by a group of homeowners and interested individuals in the Nacimiento area. Initially, the group obtained a temporary restraining order preventing water releases from the reservoir. However, the order was later released and the plaintiff's request for an injunction was denied. In addition, the court found that the Monterey County Water Resources Agency was not required to comply with CEQA in setting its yearly release schedule. The second lawsuit was settled shortly after it was filed by a recreation concessionaire at Nacimiento to maintain the recreation at the reservoir during the drought. The Monterey County Water Resources Agency agreed to retain water in the reservoir for recreation uses for the year, but the action did not set a precedent for future years.

Regional Issues

Cloud Seeding. In early 1990, the Monterey County Water Resources Agency initiated a cloud seeding program which was designed to increase rainfall and runoff for the Arroyo Seco River, as well as the San Antonio and Nacimiento reservoirs. As part of the rainfall enhancement program, aircraft seeding operations dispensed silver iodide. An experimental radio-controlled, ground-based propane dispenser was also installed in the Arroyo Seco area. Overall, the Monterey County Water Resources Agency concluded that rainfall increased from 12-16 percent for water year 1990-91.

16 to 20 percent for water year 1991-92, and preliminary results show an increase from 12 to 21 percent for water year 1992-93.

Santa Barbara County proposed a cloud seeding design for the 1992-93 winter program similar to the previous year. The proposed project design is ideally suited to conduct a state-of-the-art operation. The key components are a dedicated weather radar, a seeding aircraft, remotely controlled ground generators, a computerized GUIDE model, and an experienced weather modification meteorologist familiar with the area

For the past two years, in San Luis Obispo County, the City of San Luis Obispo, and Zone 3 of the San Luis Obispo County Flood Control and Water Conservation District conducted a cloud seeding program

Local Issues

Pajaro Valley Shortages. The Pajaro Valley is experiencing adverse effects from the recent drought, most notably ground water overdraft and accelerated sea water intrusion. About 70 homes in one development along the coastline have had their water supply affected by sea water intrusion. Local homeowners installed expensive water purification equipment, purchased bottled water, or trucked in water to solve the problem. The homeowners currently are negotiating with City of Watsonville officials to obtain a potable water supply. Watsonville officials proposed a pipeline from the city limits to the Sunset Beach area at a cost of $10,000 per home. The pipeline construction project will take approximately three years to complete, but will provide a potable water supply for the residents.

To better manage its water resources, the Pajaro Valley Water Management Agency, in cooperation with the USBR, is preparing a Basin Management Plan for the Pajaro Valley. To meet the future demands of the area, a combination of alternatives must be employed.

Pajaro Valley Water Augmentation. A Basin Management Plan for the Pajaro Valley was approved in December 1993 by the directors of the Pajaro Valley Water Management Agency. Key elements of the preferred alternative include a dam on College Lake to create a 10,000-af reservoir and a connection to the San Felipe branch of the CVP, and a coastal pipeline to meet the needs of agricultural users between Highway 1 and the ocean. The proposed San Felipe extension involves transporting water from the existing Santa Clara Conduit, a key feature of the San Felipe Division, which delivers water from San Luis Reservoir into Santa Clara County, with a fork into San Benito County. The pipeline, with a capacity up to 67 cfs, could provide a maximum annual volume of 19,900 af annually for municipal and industrial, as well as agricultural, water use in the Watsonville area. The supply for the San Felipe extension will probably come from reallocation of CVP supply. To date, no contract negotiations have occurred to bring water into the Watsonville area; however, PVWMA and USBR held several discussions to develop a process to address PVWMA needs under the CVPIA.

The Salinas Basin aquifers have been in a state of overdraft for many years resulting in sea water intrusion in the coastal areas. The rate of sea water intrusion has increased rapidly because of increased agricultural production, urban development, and the effects of the recent drought. Evidence of seawater intrusion has been detected in wells a few miles from the City of Salinas.

The Monterey County Water Resources Agency continues to investigate several methods to bring the Salinas Basin into balance These methods include both water management measures and capital facilities projects

Monterey Peninsula Problems. Improvements to the Monterey Peninsula's water supply system are needed for several reasons Water supply in average rainfall years far exceeds demand; however, the area is vulnerable to climate variability and the impact of multi-year droughts When dry years occur, shortages rapidly develop due to inadequate storage on the Carmel River and increased pumping and overdraft of ground water basins Urban growth has also contributed to the need for an increased drought period water supply Tourism, a major industry for the region, has also increased since construction of the Monterey Bay Aquarium Without an increase in the water supply for the region, the risk of more frequent shortages in dry years will increase The Monterey Peninsula Water Management District has taken a number of actions to address the need for a reliable water supply The district has already implemented several programs, including an urban water conservation program.

Water Balance

Water budgets were computed for each Planning Subarea in the Central Coast Region by comparing existing and future water demand forecasts with the forecasted availability of supply. The region total was computed by summing the demand and supply totals for all the planning subareas This method does not reflect the severity of drought year shortages in some local areas, which can be hidden when planning subareas are combined within the region Thus, there could be substantial shortages in some local areas during drought periods Local and regional shortages could also be more or less severe than the shortage shown, depending on how supplies are allocated within the region, a particular water agency's ability to participate in water transfers or demand management programs (including land fallowing or emergency allocation programs), and the overall level of reliability deemed necessary Volume I, Chapter 11 presents a broader discussion of demand management options

Table CC-11 presents water demands for the 1990 level and for future water demands to 2020 and balances them with: (1) supplies from existing facilities and water management programs, and (2) future demand management and water supply management options

Regional net water demands for the 1990 level of development totaled 1,143,000 and 1,213,000 af for average and drought years, respectively Those demands are forecasted to increase to 1,291,000 and 1,379,000 af, respectively, by the year 2020, after accounting for a 30,000-af reduction in urban water demand resulting from additional long-term water conservation measures

Urban net water demand is forecasted to increase by about 52 percent by 2020, due to projected increases in population Agricultural net water demand is forecasted to increase by about 3 percent, primarily due to an expected increase in double cropping in the region Environmental net water demands, under existing rules and regulations, will remain essentially level; however, there are several Central Coast Region streams where increases in instream flow for fisheries have been proposed

Average annual supplies, including 245,000 af of ground water overdraft, were generally adequate to meet average net water demands in 1990 for this region However during drought, present supplies are insufficient to meet present demands and, without additional water management programs, annual average and drought year shortages by 2020 are expected to increase to about 345,000 and 450,000 af, respectively

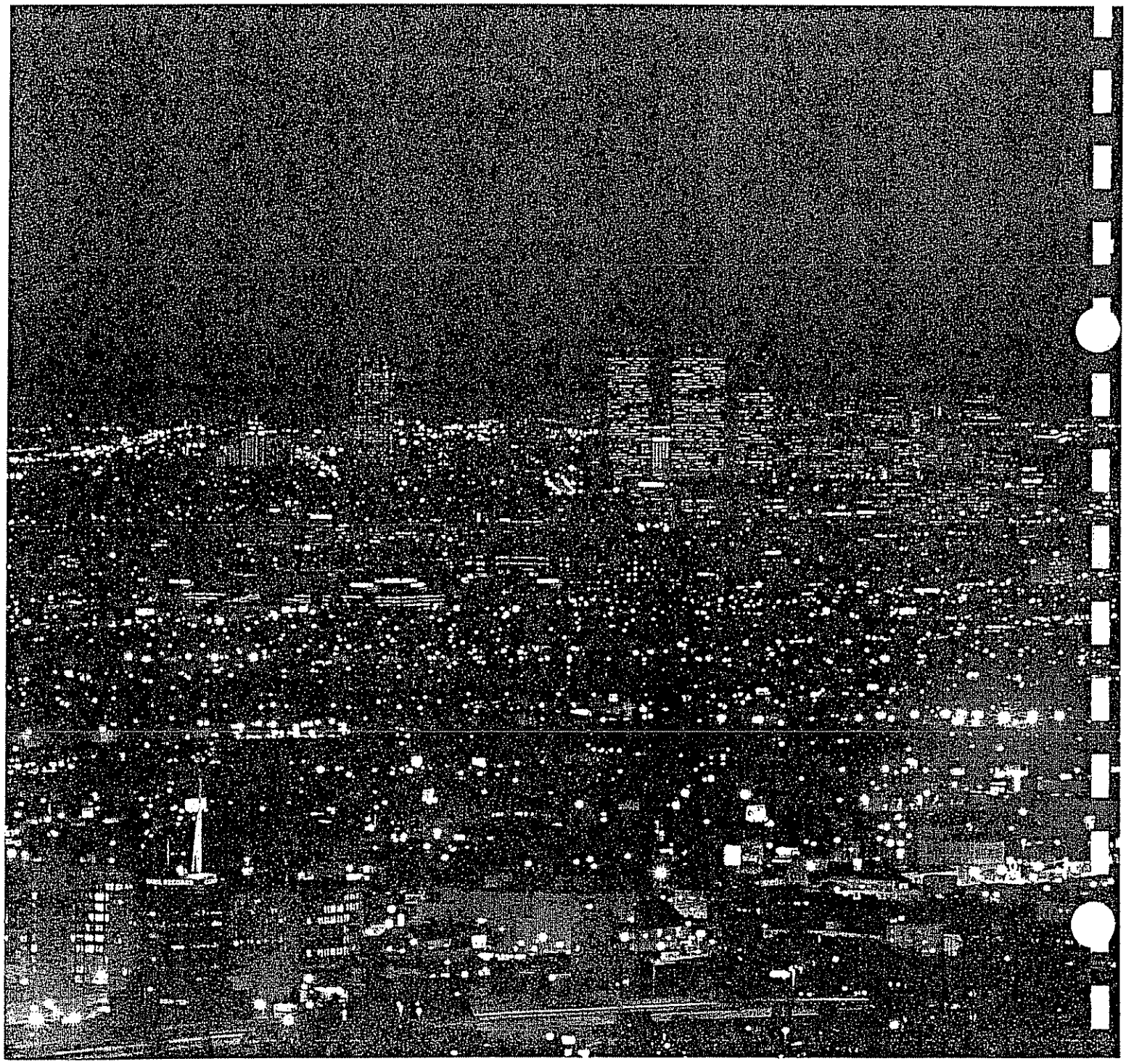
Table CC-11. Water Budget
(thousands of acre-feet)

Water Demand/Supply	*1990*		*2000*		*2010*		*2020*	
	average	*drought*	*average*	*drought*	*average*	*drought*	*average*	*drought*
Net Demand								
Urban—with 1990 level of conservation	229	233	276	281	327	334	379	387
—reductions due to long-term conservation measures (Level I)	—	—	-13	-13	-23	-23	-30	-30
Agricultural—with 1990 level of conservation	893	961	910	982	920	991	921	1,003
—reductions due to long-term conservation measures (Level I)	—	—	0	0	0	0	0	0
Environmental	1	0	1	0	1	0	1	0
Other[1]	20	19	20	19	20	19	20	19
TOTAL Net Demand	1,143	1,213	1,194	1,269	1,245	1,321	1,291	1,379
Water Supplies w/Existing Facilities Under D-1485 for Delta Supplies								
Developed Supplies								
Surface Water[2]	209	136	220	144	244	148	247	148
Ground Water	688	762	694	769	695	776	698	781
Ground Water Overdraft[3]	245	245	—	—	—	—	—	—
Subtotal	1,142	1,143	914	913	939	924	945	929
Dedicated Natural Flow	1	0	1	0	1	0	1	0
TOTAL Water Supplies	1,143	1,143	915	913	940	924	946	929
Demand/Supply Balance	0	-70	-279	-356	-305	-397	-345	-450
Level I Water Management Programs[4]								
Long-term Supply Augmentation								
Reclaimed	—	—	44	44	55	55	55	55
Local	—	—	24	22	24	22	24	22
Central Valley Project/ Other Federal	—	—	0	0	20	7	20	7
State Water Project	—	—	53	25	53	43	53	43
Subtotal - Level I Water Management Programs	0	0	121	91	152	127	152	127
Net Ground Water or Surface Water Use Reduction Resulting from Level I Programs	—	—	-19	-4	-16	-4	-15	-4
Remaining Demand/Supply Balance Requiring Short-term Drought Management and/or Level II Options	0	-70	-177	-269	-169	-274	-208	-327

(1) Includes major conveyance facility losses, recreation uses, and energy production.
(2) Existing and future imported supplies that depend on Delta export capabilities are based on SWRCB D-1485 and do not take into account recent actions to protect aquatic species. As such, regional water supply shortages are understated (note: proposed environmental water demands of 1 to 3 MAF are included in the California water budget)
(3) The degree future shortages are met by increased overdraft is unknown. Since overdraft is not sustainable, it is not included as a future supply.
(4) Protection of fish and wildlife and a long-term solution to complex Delta problems will determine the feasibility of several water supply augmentation proposals and their water supply benefits

With planned Level I water management programs, average and drought year shortages could be reduced to 208,000 and 327,000 af, respectively. The remaining shortage requires both additional short-term drought management, water transfers, and demand management programs, and future long-term Level II water management programs, depending on the overall level of water service reliability deemed necessary by local agencies, to sustain the economic health of the region. This region depends on export from the Sacramento-San Joaquin Delta for a portion of its supplies. Shortages stated above are based on D-1485 operating criteria for Delta supplies and do not take into account recent actions to protect aquatic species in the estuary. As such, regional water supply shortages are understated.

Los Angeles is California's most populated urban area. Urban land use accounts for 25 percent of the total land area in the South Coast Region.



South Coast Region

The most urbanized region in California is the South Coast. Although it covers only about 7 percent of the State's total land area, it is home to roughly 54 percent of the State's population. Extending eastward from the Pacific Ocean, the region is bounded by the Santa Barbara-Ventura county line and the San Gabriel and San Bernardino mountains on the north, the Mexican border on the south, and a combination of the San Jacinto Mountains and low-elevation mountain ranges in central San Diego County on the east. Topographically, the region is comprised of a series of broad coastal plains, gently sloping interior valleys, and mountain ranges of moderate elevations. The largest mountain ranges in the region are the San Gabriel, San Bernardino, San Jacinto, Santa Rosa, and Laguna mountains. Peak elevations are generally between 5,000 and 8,000 feet above sea level; however, some peaks are nearly 11,000 feet high. (See Appendix C for maps of the planning subareas and land ownership in the region.)

The climate of the region is Mediterranean-like, with warm and dry summers followed by mild and wet winters. In the warmer interior, maximum temperatures during the summer can be over 90°F. The moderating influence of the ocean results in lower temperatures along the coast. During winter, temperatures rarely descend to freezing except in the mountains and some interior valley locations.

About 80 percent of the precipitation occurs during the four-month period of December through March. Average annual rainfall quantities can range from 10 to 15 inches on the coastal plains and 20 to 45 inches in the mountains. Precipitation in the higher mountains commonly occurs as snow. In most years, snowfall quantities are sufficient to support a wide range of winter sports in the San Bernardino and San Gabriel mountains.

There are several prominent rivers in the region, including the Santa Clara, Los Angeles, San Gabriel, Santa Ana, Santa Margarita, and San Luis Rey. Some segments of these rivers have been intensely modified for flood control. Natural runoff of the region's streams and rivers averages around 1,200,000 af annually.

Population

Growth has been fairly steady since the first boom of the 1880s. The1990 population was up 26 percent from 12,970,000 in 1980. Much of the population

Region Characteristics

Average Annual Precipitation: 18.5 inches *Average Annual Runoff: 1,227,000 af*

Land Area: 10,950 square miles *1990 Population: 16,292,800*

increase is due to immigration, both from within the United States and from around the world. Most of the region's coastal plains and valleys are densely populated. The largest cities are Los Angeles, San Diego, Long Beach, Santa Ana, and Anaheim. Each of these is among California's top ten most populated cities; Los Angeles and San Diego also are the second and sixth largest cities in the United States, respectively. The region is also home to six of the State's ten fastest growing cities in the 50,000 to 200,000 population range. These are Corona, Fontana, Tustin, Laguna Niguel, National City, and Rancho Cucamonga. Areas undergoing increased urbanization include the coastal plains of Orange and Ventura counties, the Santa Clarita Valley in northwestern Los Angeles County, the Pomona/San Bernardino/Moreno valleys, and the valleys north and east of the City of San Diego. The region's population is expected to increase by 55 percent by 2020. Table SC-1 shows regional population projections to 2020.

Table SC-1. Population Projections
(thousands)

Planning Subarea	*1990*	*2000*	*2010*	*2020*
Santa Clara	834	1,063	1,301	1,556
Metropolitan Los Angeles	8,501	9,445	10,376	11,505
Santa Ana	4,023	5,155	6,230	7,384
San Diego*	2,935	3,610	4,191	4,870
TOTAL	16,293	19,273	22,098	25,315

* The San Diego PSA includes parts of Riverside and Orange counties

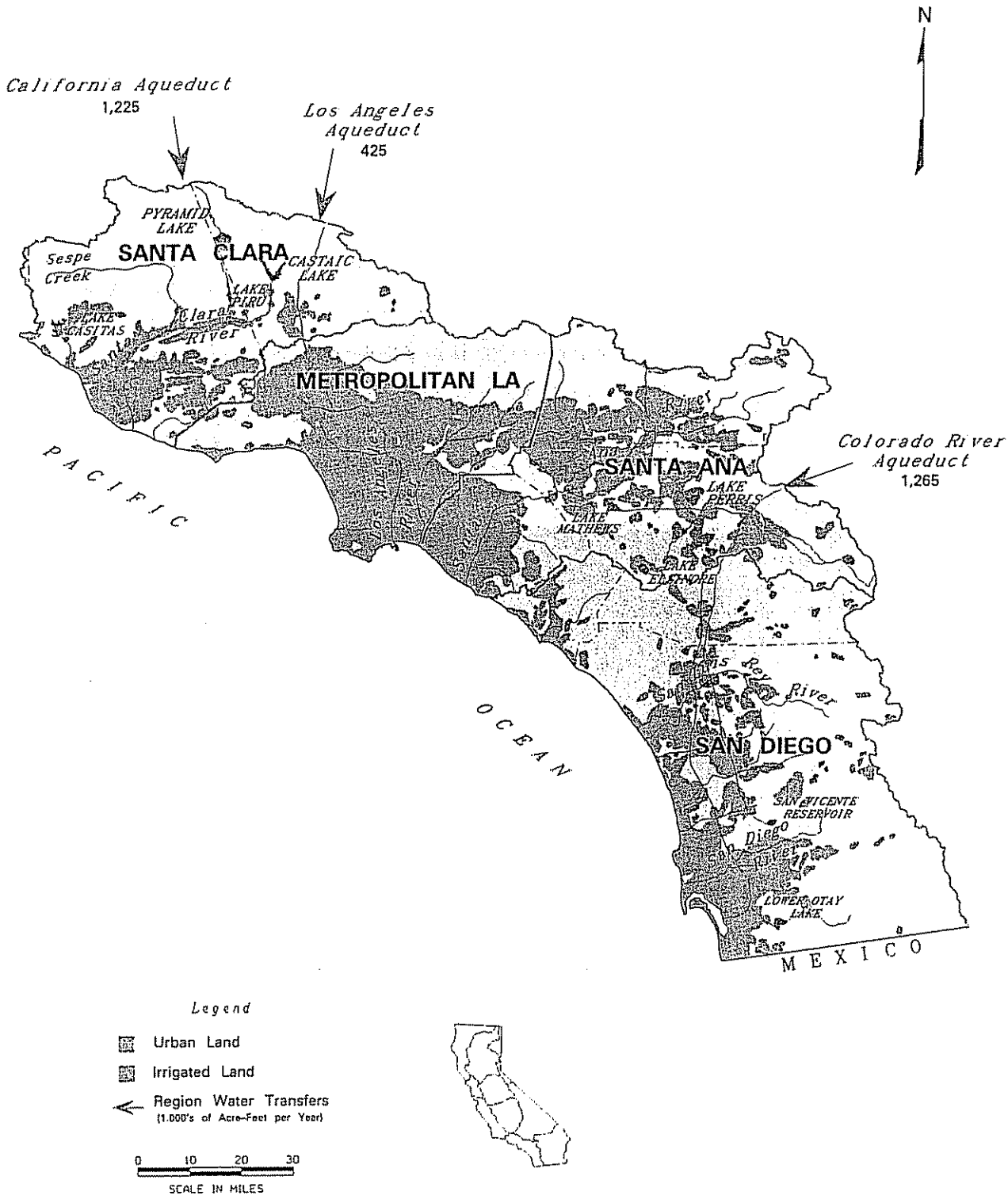
Land Use

Despite being so urbanized, about one-third of the region's land is publicly owned. Approximately 2,300,000 acres is public land, of which 75 percent is national forest. Urban land use accounts for about 1,700,000 acres, and irrigated cropland accounts for 288,000 acres. Figure SC-1 shows land use in the South Coast Region.

The major industries in the region are national defense, aerospace, recreation and tourism, and agriculture. Other large industries include electronics, motion picture and television production, oil refining, housing construction, government, food and beverage distribution, and manufacturing (clothing and furniture). While defense, aerospace, and oil refining are currently in a decline, the South Coast Region has a strong and growing commercial services sector. International trading, financing, and basic services are major economic contributors to the region.

One of the most important land use issues in the South Coast Region is whether to prohibit housing and other urban land uses from spreading into the remaining agricultural land and open space. Some of the region's agricultural land is currently protected through the State's Williamson Act. Some local governments have established agricultural preserves in their areas. The desire to retain open space in the Los Angeles area also has led to parkland status for parts of the Santa Monica Mountains. Preservation of coastal wetlands and lagoons in the region is another prime concern. A 1993 agreement between federal, State, and local agencies to protect endangered gnatcatcher habitat is a good example of protection of open space to benefit wildlife.

Figure SC-1. South Coast Region
Land Use, Imports, and Exports



The largest amount of irrigated agriculture is in Ventura County, where 116,600 acres of cropland are cultivated. Most of it is fresh market vegetables, strawberries, and citrus and avocados. San Diego planning subarea has more than 110,600 acres in irrigated agriculture, most of which is planted in citrus and avocados. Fresh market vegetables and other crops are grown in some of the county's coastal and inland valleys. The region is also ideally suited for growing other high-value crops, such as nursery products and cut flowers. Other irrigated agriculture includes forage and field crops related to the dairy industry and vineyards.

Water Supply

About 67 percent of the region's 1990 level water supply comes from surface water imports. The remaining portion is supplied by ground water (25 percent) and to a lesser extent by local surface water (6 percent) and reclaimed water (2 percent). Since the turn of the century, water development has been carried out on a massive scale throughout the South Coast Region. Steady expansion of the population and economy lead to sufficient demand and financial backing to build large water supply projects for importing water into the region. Figure SC-2 shows the region's sources of supply.

Supply with Existing Facilities and Water Management Programs

Local and imported surface water account for about 73 percent of the region's 1990 level water supply. In 1913, the Los Angeles Aqueduct began importing water from the Mono-Owens area to the South Coast region. With the addition of a second conduit in 1970, the Mono-Owens supply is about 10 percent of the region's 1990 level water supply. Court-ordered restrictions on diversions from the Mono Basin and Owens Valley have reduced the amount of water the City of Los Angeles can receive and have brought into question the reliability of Mono-Owens supply for Los Angeles (see South Lahontan Region). In 1941, the Metropolitan Water District of Southern California completed the Colorado River Aqueduct, which now provides about 29 percent of the region's supply with Colorado River water. The State Water Project began delivering water from the Sacramento-San Joaquin Delta to the South Coast region in 1972, and today furnishes about 28 percent of the region's supply. The remainder of the surface supply (about 6 percent of the 1990 level total) is provided by local projects. Table SC-2 lists the major reservoirs in the region.

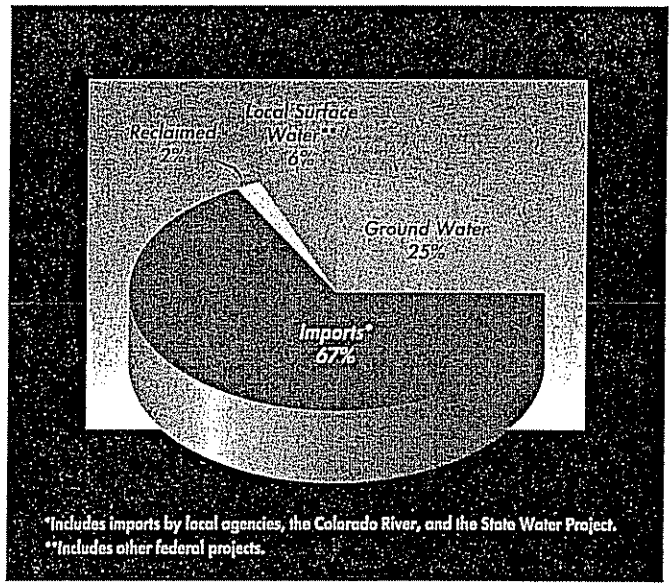


Figure SC-2. South Coast Region Water Supply Sources (1990 Level Average Conditions)

Table SC-2. Major Reservoirs

Reservoir Name	*River*	*Capacity (1,000 AF)*	*Owner*
Casitas	Coyote Creek	254	USBR
Lake Piru	Piru Creek	88.3	United WCD
Pyramid	Piru Creek	171.2	DWR
Matilija	Matilija Creek	1.5	Ventura CO FCD
Castaic	Castaic Creek	323.7	DWR
Cogswell	San Gabriel	8.9	Los Angeles CO FCD/Dept. of Public Works
San Gabriel	San Gabriel	42.4	Los Angeles CO FCD/Dept. of Public Works
Big Bear Lake (Bear Valley)	Bear Creek	73.4	Big Bear MWD
Perris	Bernasconi Pass	131.5	DWR
Mathews	Trib Cajalco Creek	179.3	MWDSC
Lake Hemet	San Jacinto River	13.5	Lake Hemet MWD
Railroad Canyon	San Jacinto River	11.9	Temescal Water Co
Irvine Lake (Santiago Creek)	Santiago Creek	25.0	Serrano ID/Irvine Ranch WD
Skinner	Tucalota Creek	44.2	MWDSC
Vail	Temecula Creek	50.0	Rancho California WD
Henshaw	San Luis Rey River	53.4	Vista ID
Lake Hodges	San Dieguito River	37.7	City of San Diego
Sutherland	Santa Ysabel Creek	29.0	City of San Diego
San Vicente	San Vicente Creek	90.2	City of San Diego
El Capitan	San Diego River	112.8	City of San Diego
Cuyamaca	Boulder Creek	11.8	Helix WD
Lake Jennings	Quail Canyon Creek	9.8	Helix WD
Murray	Chaparral Canyon	6.1	City of San Diego
Lake Loveland	Sweetwater River	25.4	Sweetwater Authority
Sweetwater	Sweetwater River	28.1	Sweetwater Authority
Lower Otay	Otay River	49.5	City of San Diego
Morena	Cottonwood Creek	50.2	City of San Diego
Barrett	Cottonwood Creek	37.9	City of San Diego
Miramar	Big Surr Creek	7.3	City of San Diego
Seven Oaks	Santa Ana	146	COE under construction
Prado	Santa Ana	183.2	COE 1941

There are numerous ground water basins along the coast and inland valleys of the region. Many of these basins are adjudicated or managed by a public agency (see Volume I, Chapters 2 and 4). Recharge occurs from natural infiltration along river valleys, but in many cases, basin recharge facilities are in place using local, imported, or reclaimed supplies. Some ground water basins are as large as several hundred square miles in area and have a capacity exceeding 10,000,000 af. The current estimated annual net ground water use approaches 1,100,000 af.

Basins close to the coast often have troubles with sea water intrusion. Historically, additional recharge or a series of injection wells forming a barrier have been used to mitigate this problem. Other ground water quality concerns are high TDS, nitrates, PCE, sulfates, pesticide contamination (DBCP), selenium, and leaking fuel storage tanks.

Approximately 82,000 af of new water was produced by recycled water in 1990, about 2 percent of the region's supply. Recycled water is most often used for irrigating freeway and other urban landscaping, golf courses, and some agricultural land; it is

also used in ground water recharge and sea water barrier projects. The Central and West Basin Water Replenishment Districts recharge the Central and West Coast ground water basins with 50,000 af per year of recycled water. The Orange County Water District injects about 5,000 af of recycled water into the ground at the Alamitos Barrier Project. This process prevents further sea water intrusion into the district's ground water supply and frees imported supplies for other uses.

Drought Water Management Strategies. To minimize the impacts caused by the shortfalls in imported surface water supplies, most agencies in the region established and implemented rationing programs during the 1987-92 drought to bring demand in line with supplies. Customer rationing allotments were determined by the customer's use prior to the drought. Rationing levels, or reductions, ranged from 15 to 50 percent.

Programs implemented by the cities of San Diego and Los Angeles are typical of the efforts agencies throughout the region made to combat recent drought-induced shortages. The City of San Diego implemented a 20-percent rationing program for its customers during 1991; a 10-percent program had been in place since 1988. Other programs and activities by San Diego included establishing customer rebates for the installation of ultra-low-flush toilets, distributing free showerheads, providing turf and home audit service, expanding the existing public information program (with a 24-hour hotline), establishing a field crew to handle waste-of-water complaints, constructing a xeriscape demonstration garden, and retrofitting city water facilities. Landscape designs for new private and public construction are regulated for water conservation by a 1986 city ordinance. San Diego also has ordinances that permit enacting water conservation measures and programs during critical water supply situations and that require all residential dwellings to be retrofitted prior to resale.

The City of Los Angeles has had a rationing program in place since 1986. The program was mandatory for all its customers until early in 1992, when it was revised to voluntary status. The program originally called for a 10-percent reduction; however, it was amended to 15 percent during 1992 when the State's water supply situation worsened. Programs established by Los Angeles are similar to those described for San Diego. Los Angeles also established a "drought buster" field program with staff patrolling neighborhoods looking for water wasters. Table SC-3 shows the region's water supplies with existing facilities and programs.

Water Management Options with Existing Facilities. MWDSC is pursuing additional supplies to replace those it has lost under recent court rulings. Water use in its service area has increased from 2,800,000 af in 1970 to 4,000,000 af in 1990. The increase reflects a large population growth. Moreover, the City of Los Angeles is increasing its reliance upon MWDSC's water to make up for its loss of imported water from the Mono-Owens Basin. Following are highlights of major MWDSC water supply and demand management programs, most of which are in place, that would provide options for additional supplies, especially in critical years.

The Imperial Irrigation District-MWDSC Water Conservation program began in January 1990. In return for financing certain conservation projects, MWDSC is entitled to the amount of water saved by IID except under limited conditions specified in the agreement. Conservation projects include lining existing canals, constructing local reservoirs and spill interceptor canals, installing nonleak gates and automation equipment, and instituting distribution system and on-farm management activities.

Table SC-3. Water Supplies with Existing Facilities and Programs

(Decision 1485 Operating Criteria for Delta Supplies)

(thousands of acre-feet)

Supply	*1990*		*2000*		*2010*		*2020*	
	average	*drought*	*average*	*drought*	*average*	*drought*	*average*	*drought*
Surface								
Local	254	118	254	118	254	118	254	118
Local imports[1]	425	208	425	208	425	208	425	208
Colorado River[2]	1,266	1,230	656	656	656	656	656	656
CVP	0	0	0	0	0	0	0	0
Other federal	22	21	22	21	22	21	22	21
SWP[1]	1,225	1,032	1,744	1,085	1,899	1,152	1,901	1,156
Ground water[3]	1,083	1,306	1,100	1,325	1,125	1,350	1,150	1,375
Overdraft[4]	22	22	—	—	—	—	—	—
Reclaimed	82	82	82	82	82	82	82	82
Dedicated natural flow	0	0	0	0	0	0	0	0
TOTAL	4,379	4,019	4,283	3,495	4,463	3,587	4,490	3,616

(1) 1990 supplies are normalized and do not reflect additional supplies delivered to offset the reduction of supplies from the Mono and Owens basins. SWP supply was used in 1990 to replace reduction of supplies from Mono and Owens basins, putting additional demand on Delta supplies. SWP supplies may be higher in any year to help recharge ground water basins for drought years.

(2) Colorado River supplies for the year 2000 and beyond reflect elimination of surplus and unused Colorado River supplies and the availability of 106,000 AF from the Colorado River region as a result of currently agreed upon conservation programs being implemented by Imperial Irrigation District. Miscellaneous perfected rights and future court decision on Indian water rights could impact Colorado River supplies to the South Coast Region.

(3) Average ground water is prime supply of ground water basins and does not include use of ground water which is artificially recharged from surface sources into ground water basins. However, the ground water includes ground water reclamation.

(4) The degree future shortages are met by increased overdraft is unknown. Since overdraft is not sustainable, it is not included as a future supply.

MWDSC has an advance delivery agreement with Desert Water Agency and Coachella Valley Water District for ground water storage. Under this agreement MWDSC makes advance deliveries of Colorado River water (conditions permitting) to the two agencies for recharging the Coachella Valley ground water basin. MWDSC, in turn, may use the SWP entitlements of the two agencies (up to 61,200 af per year). Water stored in the basin was used by the two agencies during the recent drought, enabling MWDSC to make full use of available DWA and CVWD entitlements.

Under the Chino Basin and San Gabriel Basin Cyclic Storage Agreement, imported water is delivered to and stored in the Chino and San Gabriel basins. When water supplies are abundant, advance deliveries of MWDSC's ground water replenishment supplies are provided for later use. When imported supplies are limited, MWDSC has the option of meeting the replenishment demands through surface deliveries or a transfer of the stored water. MWDSC's maximum storage entitlements are 100,000 af in the Chino Basin and 142,000 af in the San Gabriel Basin. As of July 1990, 28,000 af was stored in the Chino Basin and 58,000 af in the San Gabriel Basin. MWDSC is also planning for additional conjunctive use programs.

MWDSC promotes water reclamation through its Local Projects Program of 1981. Under this program, the district provides financial assistance for local water reclamation projects which develop new water supplies. The program's primary focus is on increasing the use of recycled water in landscape irrigation and industry, thereby reducing the demand for potable water supplies. To date, MWDSC is participating in 32 projects, with a total ultimate yield of 147,000 af per year. Currently, four additional projects submitted to MWDSC for inclusion in the program are in various

stages of review. These proposed projects have a combined estimated ultimate yield of 21,700 af per year.

MWDSC promotes conjunctive use at the local agency level under its Seasonal Storage Service Program of 1989 by discounting rates for imported water placed into ground water or reservoir storage. The discounted rate and program rules encourage construction of additional ground water production facilities allowing local agencies to be more self-sufficient during shortages. Additionally, the program is designed to reduce the member agencies' dependence upon district deliveries during the peak summer demand months. As of December 31, 1992, approximately 1,240,000 af of water was delivered as Seasonal Storage Service.

The West Basin Municipal Water District began reclaiming 1.5 mgd (1,680 af annually) of brackish ground water with a new desalination plant in the City of Torrance in 1993. This facility will help contain a seawater plume that has moved inland since the construction of the West Coast seawater injection barrier in the late 1950s.

Other water management options include water banking, short-term fallowing of farm land, desalination, reclaiming waste water (water recycling) and brackish ground water, water conservation, and additional offstream storage facilities for imported supplies.

Supply with Additional Facilities and Water Management Programs

Future water management options are presented in two levels to better reflect the status of investigations required to implement them.

- Level I options are those programs that have undergone extensive investigation and environmental analyses and are judged to have a high likelihood of being implemented by 2020.
- Level II options are those programs that could fill the remaining gap between water supply and demand. These options require more investigation and alternative analyses.

With planned Level I programs, 2020 average and drought year shortages could be reduced to 373,000 and 848,000 af, respectively, under Decision 1485 operating criteria for Delta supplies. A shortage of this magnitude could have severe economic impacts on the region. This remaining shortage requires both additional short-term drought management, water transfers, and demand management programs, and future long-term and Level II programs depending on the overall level of water service reliability deemed necessary, by local agencies, to sustain the economic health of the region. In the short-term, some areas of this region that rely on Delta exports for all or a portion of their supplies face greater uncertainty in terms of water supply reliability due to the uncertain outcome of actions undertaken to protect aquatic species in the Delta. Local water districts are seeking to improve water service reliability of their service area through water transfers, water recycling, conservation, and supply augmentation. The following paragraphs summarize the various water management programs under active consideration in the South Coast Region.

Water Management Options with Additional Facilities. The U.S. Bureau of Reclamation is studying the potential for recycled water use under its "Southern California Comprehensive Water Reclamation Study." The goal of the $6 million, three-phase study is to "identify opportunities and constraints for maximizing water reuse in Southern California." Phase I is expected to be complete in one year; the scheduling of phases II and III will be determined during the first phase. Expected

completion date is March 1999 The USBR believes the success of the study depends on the active participation of local and State agencies

MWDSC authorized preliminary studies for a 5-mgd (5,600-af-per-year) desalination pilot plant (distillation method). Although the location is undecided, plans call for the plant to be near an existing power plant on the coast. Planned ultimate capacity of the plant is 100 mgd (112,000 af per year).

The Colorado River Banking Plan is a proposal that would create an additional water supply for MWDSC by making use of available SWP water in place of Colorado River water. Under the plan, MWDSC would adjust its Colorado River diversions according to the availability of water from the SWP. In years when SWP supplies are adequate, MWDSC would take more of its SWP water and correspondingly less Colorado River water The difference between available Colorado River water and MWDSC's actual diversions would remain in Lake Mead and be credited to a water management account. Any additional water lost by spills or evaporation due to the storage of such water would be deducted from the water management account.

MWDSC, the Southern Nevada Water Authority, and the Central Arizona Water Conservation District have implemented a program to demonstrate the feasibility of interstate underground storage of Colorado River water. From 1992 to 1993, 100,000 af of Colorado River water, unused by Arizona, California, and Nevada, was diverted through the Central Arizona Project to water users in Central Arizona who reduced ground water pumping and used Colorado River water instead, thereby increasing water in ground water storage. In the future, following a flood-control release from Lake Mead or a determination that surplus Colorado River water is available, MWDSC and SNWA will be able to divert a portion of Arizona's Colorado River water while Arizona water users use the previously stored water. This arrangement protects Central Arizona water users from shortages and creates an additional water supply for MWDSC and SNWA MWDSC and SNWA have expressed interest in storing additional Colorado River water underground in Central Arizona.

A scene of typical new housing starts in the South Coast Region, in this case in the City of Irvine. The region's population is projected to increase substantially by 2020, creating an even larger demand for not only housing, but water supplies as well.

A draft Environmental Impact Report/Statement for a water storage and exchange program between MWDSC and Arvin-Edison was issued in 1992. The program would allow MWDSC to store up to 800,000 af of water in Arvin-Edison's ground water basin. This stored water would be recovered in dry years when Arvin-Edison would pump MWDSC's stored water in exchange for MWDSC receiving a portion of Arvin-Edison's Central Valley Project

water via the California Aqueduct Arvin-Edison would benefit from the program by higher ground water levels and an improved distribution system, to be funded by MWDSC, while MWDSC would have water in storage The final EIR/EIS for the program has been delayed pending resolution of environmental and institutional issues in the Sacramento-San Joaquin Delta

The Semitropic/Metropolitan Water Storage and Exchange Program would involve ground water storage and recovery operation Under the program, MWDSC would store water in the ground water basin underlying the Semitropic Water Storage District when Metropolitan's water supplies are in excess of its demand. During shortage years, Semitropic would pump MWDSC's stored water from the ground water basin into the California Aqueduct through facilities owned and operated by Semitropic A minimum pumpback of 40,000 to 60,000 af per year would be guaranteed. In addition, Semitropic could exchange a portion of its SWP entitlement water for MWDSC's stored water, thereby substantially increasing the annual yield of this program An initial agreement to store water in 1993 was executed and approximately 45,000 af of MWDSC's 1992 SWP carryover entitlement water was stored

In October 1991, MWDSC certified the final EIR for the Eastside Reservoir Project (Domenigoni Valley Reservoir) Final design and land acquisition activities for the reservoir are proceeding The ERP, combined with the ground water storage program, will: (1) maximize ground water storage by regulating imported water supplies for conjunctive use programs, (2) provide emergency water reserves if facilities are damaged as a result of a major earthquake, (3) provide supplies to reduce water shortages during droughts, (4) meet seasonal operating requirements, including seasonal peak demands, and (5) preserve operating reliability of the distribution system. This conjunctive use program should eventually provide two years of drought or carryover storage protection for MWDSC (528,000 af) The project should be completed by 1999

Under the Ground Water Recovery Program of 1991, MWDSC will improve regional water supply reliability by providing financial assistance for local agencies to recover contaminated ground water The goal of the Ground Water Recovery Program is to recover 200,000 af per year of degraded ground water. About half of this ultimate annual production will be untapped local yield The remainder will require replenishment from MWDSC's imported water to avoid basin overdraft Those projects will produce water, including during droughts, but will only receive replenishment water when imported supplies are available Currently, MWDSC has approved participation of eight projects, with an estimated ultimate production of 21,800 af per year The program is expected to reach its goal of 200,000 af per year by the year 2004. The net projected yield associated with natural replenishment from the Ground Water Recovery Program through the year 2020 is:

Year	Net Projected Yield Acre-Feet Per Year
1993	1,554
2000	86,100
2010	95,540
2020	95,540

Local surface water supplies provide a small contribution to the South Coast Region, making up only about 6 percent of the region's total supplies For the most part, during drought years, these surface supplies dry up However, during the winter,

this region can be hit with devastating floods. Many people speculate that more local surface reservoirs could help alleviate the region's need for increased imported supplies. However, the cost of developing local surface water supply projects for rare or limited runoff makes them impractical at present. Table SC-4 shows water supplies with additional Level I facilities and programs.

San Diego County Water Authority has developed a Water Resources Plan that evaluates current and future demands, and available local and imported supplies. A specified plan of resource development was adopted that satisfies the SDCWA's reliability goal of meeting all demand during average years, and no less than 88 percent of demand during a drought year. The recommended resource mix includes imported supplies, additional local supply development, and full implementation of Best Management Practices. Local supply development includes water recycling, ground water, and desalination. Carryover storage and transfers were identified to help meet the dry-year supply reliability goal. The plan examines both average water year supplies and drought year supplies and recommends a practical implementation schedule for resource development.

Table SC-4. Water Supplies with Level I Water Management Programs

(Decision 1485 Operating Criteria for Delta Supplies)

(thousands of acre-feet)

Supply	*1990*		*2000*		*2010*		*2020*	
	average	*drought*	*average*	*drought*	*average*	*drought*	*average*	*drought*
Surface								
Local	254	118	254	118	254	118	254	118
Local imports[1]	425	208	425	208	425	472	425	472
Colorado River[2]	1,266	1,230	724	724	724	724	724	724
CVP	0	0	0	0	0	0	0	0
Other federal	22	21	22	21	22	21	22	21
SWP[1]	1,225	1,032	1,770	1,067	2,142	1,832	2,235	1,832
Ground water[3]	1,083	1,306	1,159	1,384	1,195	1,419	1,219	1,444
Overdraft[4]	22	22	—	—	—	—	—	—
Reclaimed	82	82	481	481	580	580	679	679
Dedicated natural flow	0	0	0	0	0	0	0	0
TOTAL	4,379	4,019	4,835	4,003	5,342	5,166	5,558	5,290

(1) 1990 supplies are normalized and do not reflect additional supplies delivered to offset the reduction of supplies from the Mono and Owens basins. SWP supply was used in 1990 to replace reduction of supplies from Mono and Owens basins, putting additional demand on Delta supplies. SWP supplies may be higher in any year to help recharge ground water basins for drought years.

(2) Colorado River supplies for the year 2000 and beyond reflect elimination of surplus and unused Colorado River supplies, the availability of 106,000 AF from the Colorado River region as a result of currently agreed upon conservation programs being implemented by Imperial Irrigation District, and the availability of 68,000 AF from the Colorado River region as a result of an IID/MWDSC agreement negotiated but not yet executed relating to the lining of a portion of the All American Canal. Miscellaneous perfected rights and future court decision on Indian water rights could impact Colorado River supplies to the South Coast Region.

(3) Average ground water is prime supply of ground water basins and does not include use of ground water which is artificially recharged from surface sources into ground water basins. Ground water includes supply from ground water reclamation. For example, the MWDSC ground water recovery program could provide additional supplies of 85,000 AF by year 2000 and 95,000 AF by 2010 and beyond.

(4) The degree future shortages are met by increased overdraft is unknown. Since overdraft is not sustainable, it is not included as a future supply.

Water Use

Urban water demands for the South Coast Region have progressively increased over the last decade due to tremendous population growth rates and rapidly expanding urbanized areas. In many areas, urban expansion has led to reductions in agricultural acreage and water use. Figure SC-3 shows the distribution of 1990 level net water demands for the region.

Urban Water Use

Total municipal and industrial applied water use in 1990 was about 3,851,000 af (Table SC-5), an increase of 1,071,000 af from 1980. The increase is attributed to population and economic growth. Table SC-5 shows that 1990 applied urban water use in the Metropolitan Los Angeles planning subarea is about half of the region's total. Forecasts indicate that urban applied water use in the region will increase by 56 percent between 1990 and 2020.

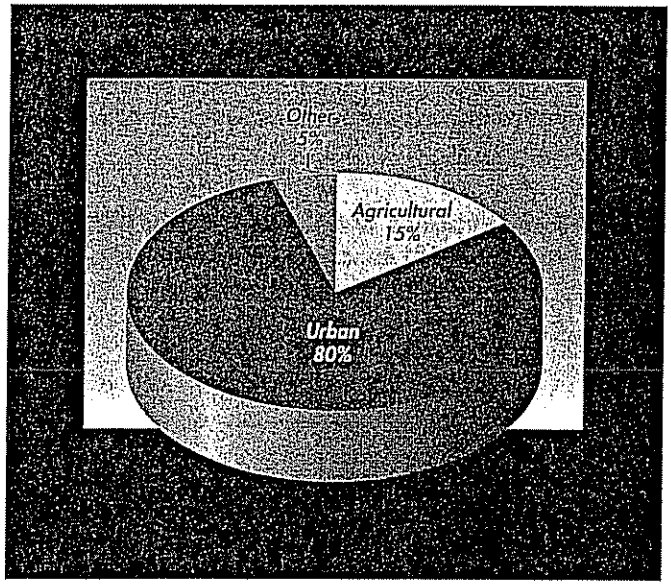


Figure SC-3. South Coast Region Net Water Demand (1990 Level Average Conditions)

Although overall demands have increased since 1980, per capita water use has leveled off somewhat in older urbanized areas. There are modest increases in the newer urbanized areas, particularly in the warmer interior sections of the region. Since there is little space for expansion, the older urban core areas are being renovated and converted from one type of use to another, such as single-family residential to multi-family residential. Such conversions tend to decrease household water use because of associated reductions in exterior water use with multi-family housing structures.

Average 1990 per capita water use by PSA for the region is 211 gpcd. This daily per capita value ranges from 246 gallons for the Santa Ana PSA to 204 gallons in the Metropolitan Los Angeles PSA. With continued water conservation, the region's average per capita water use is expected to increase slightly to 212 gpcd by 2020, primarily due to growth in inland areas of the region. Figure SC-4 shows 1990 level applied urban water demand by sector.

Table SC-5. Urban Water Demand
(thousands of acre-feet)

Planning Subarea	1990		2000		2010		2020	
	average	drought	average	drought	average	drought	average	drought
Santa Clara								
Applied water demand	183	190	231	240	287	298	345	358
Net water demand	153	158	194	201	241	250	290	301
Depletion	150	155	171	178	212	221	259	270
Metropolitan Los Angeles								
Applied water demand	1,911	1,985	2,055	2,135	2,270	2,359	2,520	2,620
Net water demand	1,833	1,904	1,971	2,048	2,177	2,263	2,417	2,512
Depletion	1,802	1,873	1,759	1,836	1,900	1,986	2,135	2,231
Santa Ana								
Applied water demand	1,067	1,111	1,344	1,401	1,665	1,736	2,020	2,108
Net water demand	848	882	1,045	1,087	1,265	1,317	1,500	1,564
Depletion	720	746	872	905	1,036	1,077	1,209	1,257
San Diego								
Applied water demand	690	711	816	841	958	988	1,123	1,158
Net water demand	677	697	800	825	940	969	1,102	1,137
Depletion	669	689	734	758	845	874	993	1,027
TOTAL								
Applied water demand	3,851	3,997	4,446	4,617	5,180	5,381	6,008	6,244
Net water demand	3,511	3,641	4,010	4,161	4,623	4,799	5,309	5,514
Depletion	3,341	3,463	3,536	3,677	3,993	4,158	4,596	4,785

Recent State laws require that most urban water wholesale and retail agencies prepare urban water management and water shortage contingency plans. Under the Urban Water Management Act of 1985 most agencies must analyze their water conveyance operations and water use in their service areas, identify areas for improvement, and develop and implement plans to correct any inefficiencies. The plans must be updated at 5-year intervals. The act requires that agencies examine operations and demands in their service area during droughts and develop plans to cope with the shortfall in supply. These plans will complement existing urban water management plans.

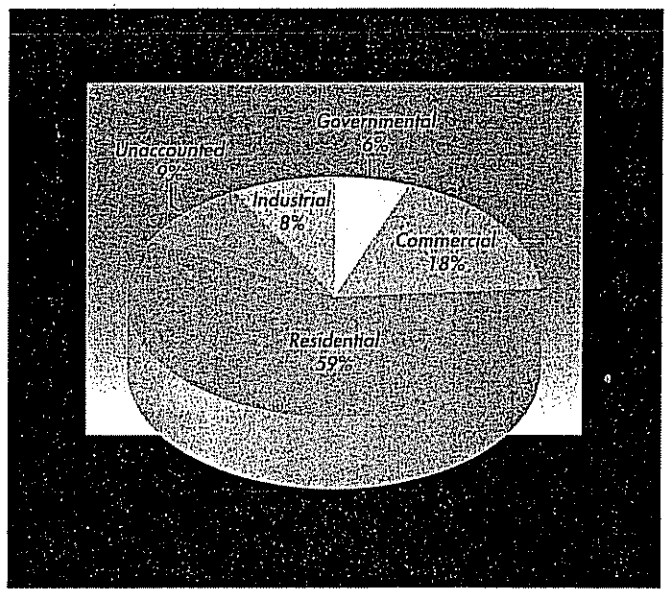


Figure SC-4
South Coast Region
Urban Applied Water
Use by Sector
(1990 Level
Average Conditions)

Most of the water conservation programs

identified in these plans are a part of a package known collectively as the *Best Management Practices* (a more detailed discussion about urban BMPs is in Volume I, Chapter 6). BMPs help agencies develop specific strategies to augment or stretch their dependable water supplies to meet ever-increasing water demands within their service areas. Plans must be implemented on a set timetable once an agency decides to adopt these practices.

Since 1980, many water and local governmental agencies have developed and implemented water conservation programs, similar to those required on the Best Management Practices list. Many local agencies provide technical assistance to schools who wish to incorporate discussions on water resources and conservation into their natural science curricula. Total urban water use will be reduced through these ongoing programs, which include implementing BMPs, building and plumbing code modifications, and more efficient irrigation operations for major landscaping projects.

Agricultural Water Use

Total agricultural applied water use for the normalized 1990 level was approximately 727,000 af, a decrease of approximately 26 percent since 1980. The Santa Clara PSA used the most agricultural water in 1990, roughly 34 percent of the total, followed closely by San Diego PSA with 33 percent and Santa Ana PSA with 31 percent. The Metropolitan Los Angeles PSA had the least demand, using only about 2 percent of the region's total applied agricultural water. Figure SC-5 shows the irrigated acreage, ETAW, and applied water for major crops grown in the region.

The South Coast Region's 1990 normalized crop acreage was almost 319,000 acres (Table SC-6). The major agricultural operations in the region are found in the Santa Clara, San Diego, and Santa Ana PSAs. A 42-percent decrease in total irrigated crop acres (including multiple cropped acres) is forecast for the region, to about 184,000 acres by 2020. This is primarily due to urbanization of irrigated lands, while rising water costs and reduced water supply reliability are also contributing factors. The region's total irrigated land acreage is forecasted to decrease by about 117,000 acres over the same time period.

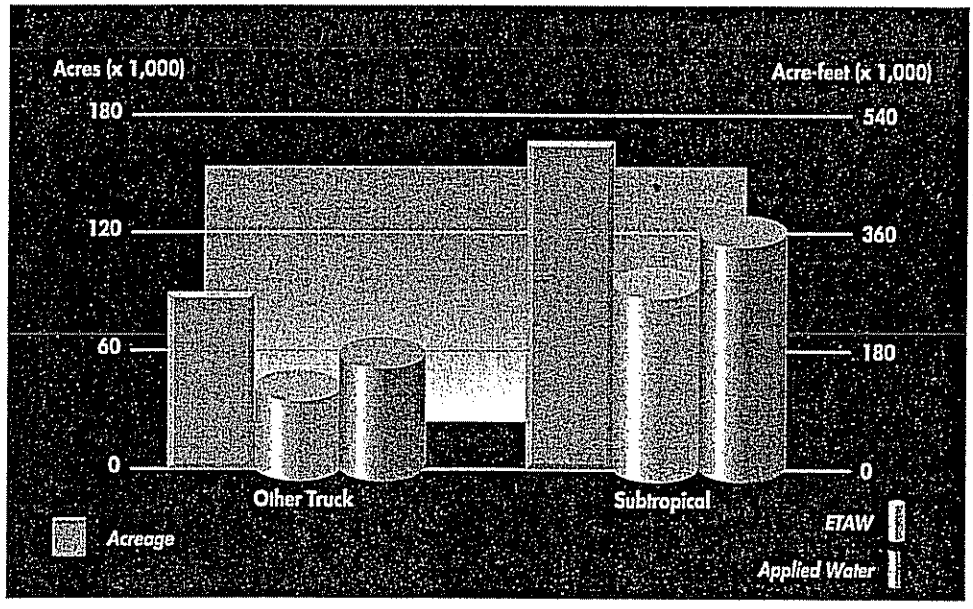


Figure SC-5. South Coast Region Acreage, ETAW, and Applied Water for Major Crops

Table SC-6. Irrigated Crop Acreage
(thousands of acres)

Planning Subarea	*1990*	*2000*	*2010*	*2020*
Santa Clara	118	110	94	71
Metropolitan Los Angeles	7	6	5	5
Santa Ana	83	66	48	30
San Diego*	111	105	88	78
TOTAL	319	287	235	184

* The San Diego PSA includes portions of Riverside and Orange counties.

The five major crops produced in the region are subtropical fruit, truck (vegetables and nursery products), improved pasture, grains, and alfalfa (Table SC-7). Slightly more than half of the total cropped acres and gross applied water in the region is associated with citrus and subtropical fruit orchards. Citrus (mostly oranges, lemons, and grapefruit) is found in all parts of the South Coast Region, but the largest amounts are in the San Diego and Santa Clara PSAs. Avocados are generally grown in the hills above the Santa Clara River in Ventura County and in the hills in the extreme southwestern part of Riverside County (Santa Ana PSA) and San Diego County. The region also has a substantial cut-flower industry. Truck crops follow citrus and subtropical fruit in terms of planted and harvested acres and use of applied water. Small acreages of irrigated grain are cultivated in southern San Diego County, southwestern San Bernardino County, and southwestern Riverside County. Irrigated pasture and alfalfa are grown primarily in southwestern San Bernardino County.

Table SC-7. 1990 Evapotranspiration of Applied Water by Crop

Irrigated Crop	*Total Acres (1,000)*	*Total ETAW (1,000 AF)*
Grain	11	2
Corn	5	7
Other field	4	8
Alfalfa	10	26
Pasture	20	55
Tomatoes	9	20
Other truck	87	123
Other deciduous	3	8
Vineyard	6	9
Citrus/olives	164	282
TOTAL	319	540

Vineyards in Pomona Valley are on the decline; however, modest acreages in southwestern Riverside County have remained stable since 1980. Deciduous tree crops are relatively small, but there is a concentration of apples and pears in central San Diego County.

Unharvested avocados hang in trees in Fallbrook, an agricultural community near San Diego. Agricultural land use is declining in the region.

Even though the region's forecasted acres are expected to decline, subtropical fruits, vegetables and flowers, truck crops, and nursery products will continue to produce significant revenues on the remaining acres.

Water conservation efforts by the growers will contribute to the reduction of agricultural water demands in the region. Most citrus and subtropical growers use the latest irrigation system technologies of drip emitters and low-flow sprinklers. Growers are also managing their irrigation operations with more efficiency. The best potential for conservation beyond current achievements will be in the citrus and subtropical orchard irrigation operations. Much of the potential for savings will occur by the end of the decade, possibly up to an additional 5 percent. Increased use of drip irrigation, improved furrow irrigation, plastic mulches, and irrigation scheduling services will save water in the other crop categories too.

Table SC-8 shows 1990 level and forecasted agricultural water demand in the region. Drought year demands reflect the need for additional irrigation to replace water normally supplied by rainfall and to meet higher-than-normal evapotranspiration demands. The region's total applied agricultural water use is expected to decrease 47 percent by 2020. Urbanization of irrigated agricultural land is the main factor in this reduction. Other factors include continued improvements in on-farm irrigation operations and irrigation system technologies. Decreases range from about 66 percent to 34 percent among the PSAs.

Table SC-8. Agricultural Water Demand
(thousands of acre-feet)

Planning Subarea	1990		2000		2010		2020	
	average	drought	average	drought	average	drought	average	drought
Santa Clara								
Applied water demand	245	256	222	233	184	193	138	145
Net water demand	214	224	197	207	167	175	126	133
Depletion	214	224	197	207	167	175	126	133
Metropolitan Los Angeles								
Applied water demand	15	16	11	12	10	11	9	9
Net water demand	13	14	10	11	9	9	8	8
Depletion	13	14	10	11	9	9	8	8
Santa Ana								
Applied water demand	227	232	179	181	127	129	77	78
Net water demand	186	190	149	152	109	110	68	69
Depletion	186	190	149	152	109	110	68	69
San Diego								
Applied water demand	240	249	220	229	178	185	158	164
Net water demand	231	240	213	222	173	180	154	160
Depletion	231	240	213	222	173	180	154	160
TOTAL								
Applied water demand	727	753	632	655	499	518	382	396
Net water demand	644	668	569	592	458	474	356	370
Depletion	644	668	569	592	458	474	356	370

Environmental Water Use

Currently, the State's San Jacinto Wildlife Area occupies approximately 5,000 acres, and there are applications to increase the size of the facility by 1,600 acres. The SJWA is run by the Department of Fish and Game. It is unique in that it is the first such operation in the State to use recycled water. Eastern Municipal Water District supplies the facility with recycled water from its Hemet/San Jacinto Water Reclamation Plant. Recycled water allocations to the SJWA are 2,200 af a year, even though only 400 af and 800 af were used in 1990 and 1991, respectively. By the year 2000, the allocation will be 4,500 af. Table SC-9 shows wetland water needs to 2020.

Additional environmental water supply requirements may be needed for the Sespe Wilderness. This preserve is in the Ventura County portion of the Los Padres National Forest and totals approximately 219,700 acres. A portion of Sespe Creek has been added to the federal list of Wild and Scenic Rivers.

Table SC-9. Wetland Water Needs
(thousands of acre-feet)

Wetland	*1990*		*2000*		*2010*		*2020*	
	average	*drought*	*average*	*drought*	*average*	*drought*	*average*	*drought*
San Jacinto WA								
Applied water demand	2	2	6	6	6	6	6	6
Net water demand	2	2	6	6	6	6	6	6
Depletion	2	2	6	6	6	6	6	6
TOTAL								
Applied water demand	2	2	6	6	6	6	6	6
Net water demand	2	2	6	6	6	6	6	6
Depletion	2	2	6	6	6	6	6	6

Other Water Demand

Recreational water use in the South Coast Region amounted to almost 23,000 af in 1990. Most recreational facilities in the region consist of campgrounds and parks, and their use entails water for lawns, toilets, showers, and facility maintenance and public service. Use in the Santa Clara, Metropolitan Los Angeles, Santa Ana, and San Diego PSAs in 1990 amounted to about 8,000 af; 8,000 af; 3,000 af; and 3,000 af, respectively. Figure SC-6 shows water recreation areas in the South Coast Region

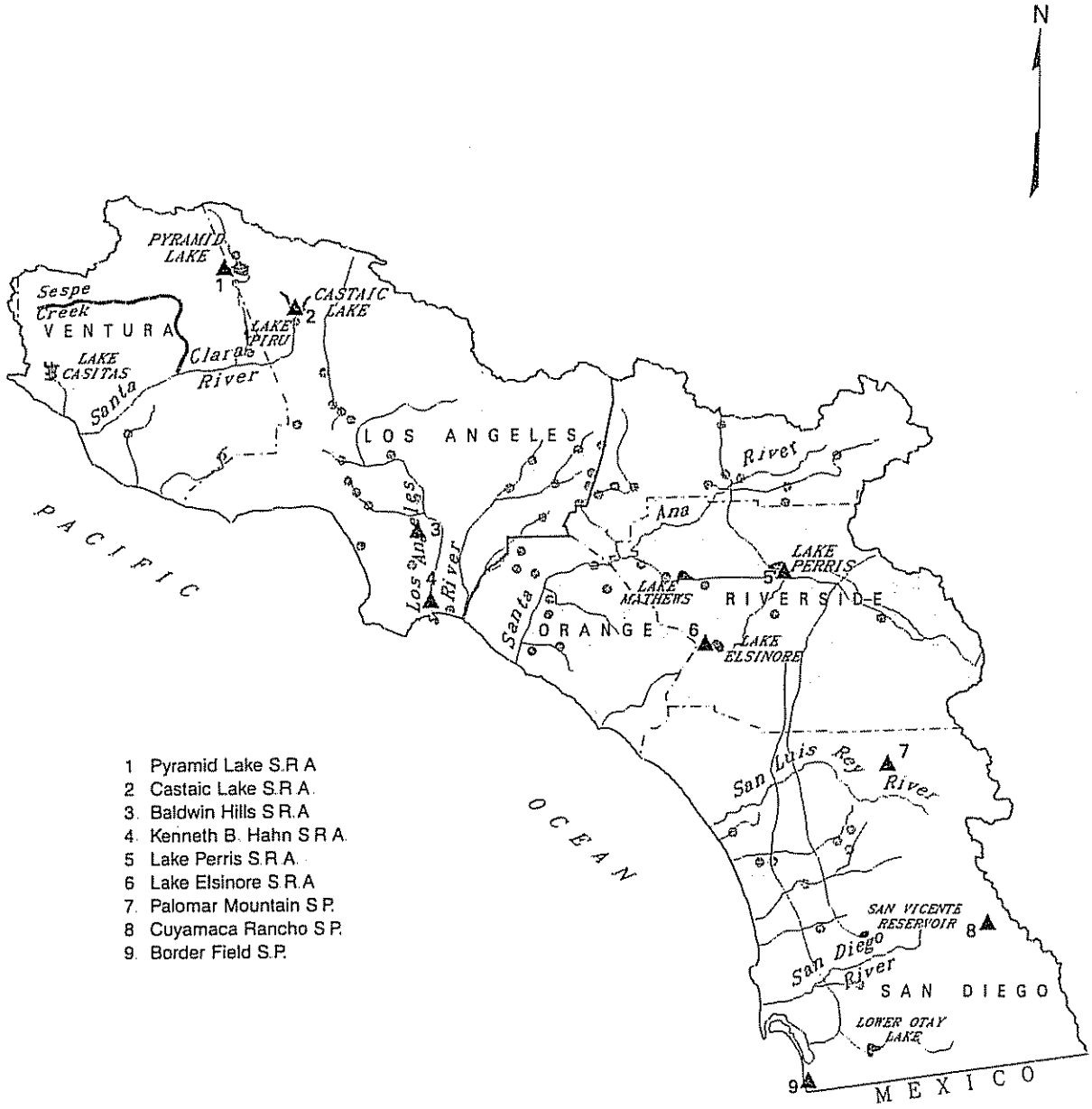
Conveyance losses account for 160,000 af and are realized in the transmission of water via the three major aqueducts in the region. Cooling water for power plants amounts to 35,000 af, while approximately 5,000 af is used to inject water in deep wells to extract oil. Table SC-10 shows total water demand forecasts to 2020 for the South Coast Region.

Issues Affecting Local Water Resource Management

Each PSA in the region has its own set of geographic and demographic conditions which present several water management issues. In general, though, the South Coast Region faces several critical water supply issues, most notably increasing demand with limited ability to increase supply, and ground water degradation. The most significant events in recent years regarding regional water supplies were the court decisions regarding Mono Lake and Colorado River diversions

Figure SC-6. South Coast Region

Hydroelectric Power Plants, Wild and Scenic Rivers, and Water Recreation Areas



*From 1992 California Energy Commission Maps See Table D-3 in Appendix D for plant information

Table SC-10. Total Water Demands
(thousands of acre-feet)

Category of Use	1990		2000		2010		2020	
	average	drought	average	drought	average	drought	average	drought
Urban								
Applied water demand	3,851	3,997	4,446	4,617	5,180	5,381	6,008	6,244
Net water demand	3,511	3,641	4,010	4,161	4,623	4,799	5,309	5,514
Depletion	3,341	3,463	3,536	3,677	3,993	4,158	4,596	4,785
Agricultural								
Applied water demand	727	753	632	655	499	518	382	396
Net water demand	644	668	569	592	458	474	356	370
Depletion	644	668	569	592	458	474	356	370
Environmental								
Applied water demand	2	2	6	6	6	6	6	6
Net water demand	2	2	6	6	6	6	6	6
Depletion	2	2	6	6	6	6	6	6
Other[1]								
Applied water demand	62	57	67	62	72	67	72	67
Net water demand	222	210	227	215	232	220	232	220
Depletion	222	210	227	215	232	220	232	220
TOTAL								
Applied water demand	4,642	4,809	5,151	5,340	5,757	5,972	6,468	6,713
Net water demand	4,379	4,521	4,812	4,974	5,319	5,499	5,903	6,110
Depletion	4,209	4,343	4,338	4,490	4,689	4,858	5,190	5,381

(1) Includes major conveyance facility losses, recreation uses, and energy production.

Legislation and Litigation

Legislation and litigation played a very important part in developing water supplies for the South Coast Region. Most court decisions and legislation that affect the region are those which also affect statewide water resources. A complete discussion of these decisions and laws are in Volume I, Chapter 2.

MWDSC is the largest water purveyor in the region; it has 27 member agencies, some of whom rely solely on MWDSC for their water supply. Many other agencies, like the City of Los Angeles, rely on MWDSC to supplement their existing water supplies. MWDSC lost a large part of an extremely important supply of water when its Colorado River entitlement was cut by 662,000 af; the City of Los Angeles lost a large part of an important supply of water when its Mono Lake and Owens Valley water supplies were reduced.

A brief synopsis of agreements and litigation which affect regional water matters follows:

Untreated Sewage from Mexico. Tijuana's excess sewage has plagued the City of San Diego and its South Bay beaches since the 1930s. During frequent failures of Tijuana's inadequate, antiquated sewage treatment system, millions of gallons of raw sewage have been carried across the border through the Tijuana River to its estuary in San Diego County. San Diego's first attempt to alleviate this nuisance was in 1965, when the city agreed to treat Tijuana's waste on an emergency basis. In 1983, the

United States and Mexico signed an agreement stating that Mexico would modernize and expand Tijuana's sewage and water supply system and build a 34-mgd sewage treatment plant

Mexico received a grant for $46 4 million from the Inter-American Development Bank to help finance the expansion and was to spend an additional $11 million to build the waste water treatment plant. 5 miles south of the International Border. Phase I of the facility was completed in January 1987. The plant was fully operational in September 1987. only to break down a month later. In May 1988. the facility was again operational

A future facility will be funded jointly by Mexico and the U.S. at a cost of $192 million. Additional phases will be added as needed, with an ultimate capacity of 100 mgd. The effluent will be discharged to the Pacific Ocean just north of the Mexican border and will meet U.S standards

San Bernardino Ground Water. As late as the 1940s, the lowest portion of the San Bernardino Valley was composed mainly of springs and marshlands. It now boasts a thriving urban complex and industrial center. but ground water levels in the area remain high. impairing the use of some buildings. The San Bernardino Valley Municipal Water District began alleviating the high ground water problem by pumping ground water from the pressure area to the Colton-Rialto Basin through the Baseline Feeder.

In 1969. the Superior Court of Riverside County. in response to a lawsuit filed by the Western Municipal Water District of Riverside County against the East San Bernardino County Water District. limited the amount of water that can be produced or exported from the San Bernardino Basin area. The ruling requires the SBVMWD to replenish the basin when ground water pumping exceeds the specified amount.

Local Issues

Ventura County Ground Water. Ground water is the main water supply for irrigation and urban uses over much of the coastal plain of Ventura County (including the Oxnard Plain). As a result of increasing water demand, the ground water aquifers underlying the plain have been overdrafted. The overdraft within the United Water Conservation District averaged 18.900 af per year during 1976-85. The Fox Canyon Ground Water Management Agency was formed to manage the ground water resources underlying the Fox Canyon aquifer zone. To eliminate the overdraft in all aquifer zones. the agency adopted ordinances requiring meter installation on all wells pumping more than 50 af per year. The objective of the ordinances is to limit the amount of ground water that can be pumped and to restrict drilling of new wells in the North Las Posas Basin. In February 1991. United Water Conservation District completed construction of the Freeman Diversion Improvement Project on the Santa Clara River. The improved structure increases average annual diversions by about 43 percent, from 40.000 af to 57.000 af. The diverted water is used for ground water recharge and agricultural irrigation. thereby reducing agricultural ground water demand.

In an effort to prevent degradation of the Ojai ground water basin. a coalition of growers. public agencies. water utilities. and pumpers decided in early 1990 to have legislation enacted to form the Ojai Basin Ground Water Management Agency. Its activities include implementing agency ordinances; monitoring key wells; determining amounts of extractions. ground water in storage. and operational safe yield; surveying land use within the agency's boundaries; compiling water quality data; and recharging the basin

Water Balance

Water budgets were computed for each planning subarea in the South Coast Region by comparing existing and future water demand forecasts with the forecasted availability of supply. The region total was computed by summing the demand and supply totals for all the planning subareas. This method does not reflect the severity of drought year shortages in some local areas which can be hidden when planning subareas are combined within the region. Thus, there could be substantial shortages in some areas. Local and regional shortages could also be more or less severe than the shortage shown, depending on how supplies are allocated within the region, a particular water agency's ability to participate in water transfers or demand management programs (including land fallowing or emergency allocation programs), and the overall level of reliability deemed necessary. Volume I, Chapter 11 presents a broader discussion of demand management options.

Table SC-11 presents water demands for the 1990 level and for future water demands to 2020 and compares them with: (1) supplies from existing facilities and water management programs, and (2) future demand management and water supply management programs.

Regional net water demands for the 1990 level of development totaled 4,379,000 and 4,521,000 af for average and drought years, respectively. Those demands are forecasted to increase to 5,903,000 and 6,110,000 af, respectively, by the year 2020. This forecast accounts for a 490,000-af reduction in urban water demand resulting from implementation of long-term conservation measures, and a 10,000-af reduction in agricultural demand resulting from additional long-term water conservation measures.

Urban net water demand is projected to increase by about 1,798,000 af by 2020, primarily due to expected increases in population; agricultural net water demand is forecasted to decrease by about 288,000 af, primarily due to lands being taken out of production resulting from the high cost of imported water supplies and urbanization. Environmental net water demands, under existing rules and regulations, are forecasted to increase from 2,000 to 6,000 af annually due to increased acreage at the San Jacinto Wildlife Area.

Average annual supplies, including 22,000 af of ground water overdraft, were generally adequate to meet average net water demands in 1990 for this region. However, during drought, present supplies are insufficient to meet present demands and, without additional water management programs, annual average and drought year shortages are expected to increase to nearly 1,413,000 and 2,494,000 af by 2020, respectively. With implementation of Level I programs, shortages could be reduced to 373,000 af and 848,000 af for average and drought years, respectively. This region depends on exports from the Sacramento-San Joaquin Delta for a portion of its supplies. Shortages stated above are based on Decision 1485 operating criteria for Delta supplies and do not take into account reduction of Delta supplies due to recent actions to protect aquatic species in the estuary. As such, regional water supply shortages are understated.

Table SC-11. Water Budget
(thousands of acre-feet)

Water Demand/Supply	*1990*		*2000*		*2010*		*2020*	
	average	*drought*	*average*	*drought*	*average*	*drought*	*average*	*drought*
Net Demand								
Urban—with 1990 level of conservation	3,511	3,641	4,228	4,379	5,004	5,180	5,799	6,004
—reductions due to long-term conservation measures (Level I)	—	—	-218	-218	-381	-381	-490	-490
Agricultural—with 1990 level of conservation	644	668	572	595	465	481	366	380
—reductions due to long-term conservation measures (Level I)	—	—	-3	-3	-7	-7	-10	-10
Environmental	2	2	6	6	6	6	6	6
Other[1]	222	210	227	215	232	220	232	220
TOTAL Net Demand	4,379	4,521	4,812	4,974	5,319	5,499	5,903	6,110
Water Supplies w/Existing Facilities Under D-1485 for Delta Supplies								
Developed Supplies								
Surface Water[2]	3,274	2,691	3,183	2,170	3,338	2,237	3,340	2,241
Ground Water	1,083	1,306	1,100	1,325	1,125	1,350	1,150	1,375
Ground Water Overdraft[3]	22	22	—	—	—	—	—	—
Subtotal	4,379	4,019	4,283	3,495	4,463	3,587	4,490	3,616
Dedicated Natural Flow	0	0	0	0	0	0	0	0
TOTAL Water Supplies	4,379	4,019	4,283	3,495	4,463	3,587	4,490	3,616
Demand/Supply Balance	0	-502	-529	-1,479	-856	-1,912	-1,413	-2,494
Level I Water Management Programs[4]								
Long-term Supply Augmentation								
Reclaimed	—	—	399	399	498	498	597	597
Local	—	—	0	0	0	264	0	264
Colorado River	—	—	68	68	68	68	68	68
State Water Project	—	—	26	22	243	680	334	676
Subtotal - Level I Water Management Programs	0	0	493	489	809	1,510	999	1,605
Net Ground Water or Surface Water Use Reduction Resulting from Level I Programs	—	—	36	36	47	46	41	41
Remaining Demand/Supply Balance Requiring Short-term Demand Management and/or Level II Options	0	-502	0	-954	0	-356	-373	-848

(1) Includes major conveyance facility losses, recreation uses, and energy production.
(2) Existing and future imported supplies that depend on Delta export capabilities are based on SWRCB D-1485 and do not take into account recent actions to protect aquatic species. As such, regional water supply shortages are understated (note: proposed environmental water demands of 1 to 3 MAF are included in the California water budget).
(3) The degree future shortages are met by increased overdraft is unknown. Since overdraft is not sustainable, it is not included as a future supply.
(4) Protection of fish and wildlife and a long-term solution to complex Delta problems will determine the feasibility of several water supply augmentation proposals and their water supply benefits.

Sunset over the Sacramento River near Redding. The river provides many recreational opportunities, habitat for fish and wildlife, and water supplies for much of the region.